U. S. DEPARTMENT OF AGRICULTURE

DIVISION OF CHEMISTRY

BULLETIN No. 39

EXPERIMENTS

WITH

SUGAR BEETS

IN

1893

BY

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF CHEMISTRY,
Washington, D. C., January 13, 1894.

SIR: I transmit herewith, for your inspection and approval, the manuscript of Bulletin 39 of the Division of Chemistry. This bulletin contains the results of the miscellaneous experiments in the culture of sugar beets in various parts of the United States, and of the experiments in the same line of work conducted by the Department at Schuyler, Nebr., during the season of 1893.

Respectfully,

H. W. WILEY,
Chief of the Division of Chemistry and Director of the Experiment Station at Schuyler

Hon. J. STERLING MORTON,
Secretary of Agriculture.

CONTENTS.

EXPERIMENTS WITH SUGAR BEETS IN 1893.

WORK OF THE YEAR.

In harmony with the provisions of the act of Congress for experiments in the improvement of sugar-producing plants and the manufacture of sugar therefrom, and by direction of the Secretary of Agriculture, the work of the Department in this direction was continued in two distinct lines.

The first of these consisted in the distribution of beet seed to those interested in the culture of the beet, as indicated in the report of last year. The Department having made no purchase of beet seed for distribution, Mr. H. T. Oxnard kindly donated for its use a sufficient amount of the best imported seed.

SUGAR-BEET SEED DISTRIBUTED.

The number of packages of seed sent out was 2,428, and the number of persons to whom sent, 348. The number of packages sent to each of the different States and Territories receiving seed was as follows:

	Packages.
Alabama	12
Arizona	1
Arkansas	32
California	347
Colorado	202
Connecticut	1
Delaware	10
Florida	3
Georgia	200
Idaho	4
Illinois	17
Indiana	83
Iowa	62
Kansas	12
Kentucky	3
Louisiana	111
Maine	1
Maryland	13
Michigan	43
Minnesota	69
Mississippi	14
Missouri	27
Montana	2
Nebraska	120
Nevada	50
New Jersey	10
New Mexico	52
New York	90
North Carolina	5
North Dakota	34
Ohio	68
Oklahoma	8
Oregon	6
Pennsylvania	3
Rhode Island	3
South Dakota	176
Tennessee	15
Texas	4
Virginia	33
Washington	250
West Virginia	1
Wisconsin	219
Wyoming	12
Total	2,428

The number of packages of seed distributed was far less than in previous years, and the number of samples received for analysis was correspondingly diminished. The total number of samples received at the Chicago laboratory was 199, and the total number of samples received at the Washington laboratory was 84.

Accompanying each package of seed there was sent a copy of Farmers' Bulletin No. 3, which contains detailed instructions for preparing the land, planting the seed, and cultivating the beet.

SUGAR-BEET ANALYSES AT WORLD'S FAIR.

Arrangements were also made for taking samples for analysis, and these samples were sent chiefly to the chemical laboratory of the Department at the World's Columbian Exposition. As has already been indicated, one of the chief features of the chemical laboratory at the Exposition was the arrangement for the analysis of beets. In addition to this the Chicago laboratory was nearer to the localities in which the beets were chiefly grown, so that they could be sent for analysis in a shorter time than if forwarded to Washington. It was thought, also, that it would be an excellent illustration of the practical work of the laboratory to have the analyses made where they could be viewed by those interested. The wisdom of this course was apparent from the fact that at all times when analyses of beets were in progress large numbers of intelligent observers were watching the work. The questions which they asked showed that they were interested in the process and were receiving valuable instruction from observing it. Some of the samples of beets, however, were sent to the laboratory at Washington for examination.

UNSATISFACTORY RESULTS OF EXPERIMENTS.

The general results of the work this year were somewhat discouraging as compared with previous years. Throughout a great part of the beet-growing region the summer was excessively dry, and large numbers of total failures were reported.

In former reports attention has been called to the fact that the present method of experiment is unsatisfactory, and the reasons therefor have been fully set forth. The farmers are so busy with other work that, as a rule, they are not able to give the proper attention to the experimental details. They do not have the time to properly prepare the soil for beet culture nor do they give the growing beet proper attention. When the time for harvesting comes they are usually engaged in other farm work, so that the beets are not harvested at the proper time nor are proper data obtained by means of which any accurate estimate of the yield per acre can be determined. The analytical data, therefore, of such work are usually fragmentary and far from teaching any valuable lesson in regard to the industry itself. In general, how-

ever, the data bear out those of previous years in showing the areas in this country where the best beets can be grown. It is in these regions that the development of the industry must be expected.

There is probably not a State or Territory in the Union which is not capable of growing a fair article of sugar beets. Even in the far south beets of fair sugar content have been produced and with good tonnage; but when the competition of the world is to be met, with the price of sugar as low as it is now, only those parts of the country where the soil and climate are especially favorable can be expected to compete successfully with the beet-sugar industry already firmly established in older countries. The sole valuable lesson, therefore, of the promiscuous distribution of beet seed is in the fact that as a rule those regions best suited to the growth of the sugar beet will gradually be outlined, and intending investors led to the proper localities for the establishment of factories.

The great success of the beet-sugar industry on the Pacific coast leads to the conclusion that if the northern part of the eastern and central portions of our country is to become the seat of a great sugar industry, every possible advantage must be taken of soil and location in order to compete successfully with the beet fields of California, Washington, and Oregon.

RESULTS OF ANALYSES OF BEETS RECEIVED.

In the following table are given (by counties and States) the results of the analyses of the samples received from each State:

Table of analyses of beets grown in different parts of the

ALABAMA.

Serial No.	Name of grower.	Post-office.	County.	Variety.	Time of planting.
1	H. L. Oliver	Calera	Shelby		

COLORADO.

17252	F. W. Kraeger	Cortez	Montezuma	Vilmorin	May 5
22	Louis Lauer	Montrose	Montrose	Kleinwanzlebener	Apr. 25
87	F. A. Huntley	Rocky Ford	Otero	Vilmorin's Improved	May 16
88	do	do	do	Dippe's Kleinwanzlebener.	May 17
89	do	do	do	Vilmorin's Richest	do
90	do	do	do	Vilmorin's Improved	May 16
91	do	do	do	Knauer's Imperial	May 17
92	do	do	do	Silesian	do
93	do	do	do	do	June 7
94	do	do	do	Vilmorin's Improved	June 5
17323	Doch Seaman	do	do	Vilmorin	
17324	do	do	do	Kleinwanzlebener	

IDAHO.

161	Joseph L. Hagemann	Genesee	Latah		May 15
162	Edward Kempf	do	do		May 9

INDIANA.

17250	Snead Thomas	Marion	Grant	Kleinwanzlebener	May 10
99	John Hains	Pendleton	Madison	Knauer's Imperial	May 20
17328	Chas. F. Muth	Morristown	Shelby		

IOWA.

17257	W. J. Grunewald	Blairstown	Benton	Vilmorin's Richest	May 20
17258	do	do	do	Kleinwanzlebener	do
17262	do	do	do	Knauer's Imperial	do
17313	Henry Bash	Conrad Grove	Grundy		
61	G. A. Ivins	Iowa Falls	Hardin		May 1
17314	A. A. Berry	Clarinda	Page		May 30

KANSAS.

59	H. G. Lamson	Girard	Crawford	Knauer	Apr. 15

LOUISIANA.

46	John J. Bailey	Shreveport	Caddo		May 17
175	do	do	do	Vilmorin's Richest	do

MICHIGAN.

14	Sanford Rogers	Hastings	Barry	Kleinwanzlebener Elite No. 1.	May 2
17253	Christian Voss	Frankenlust	Bay		
17254	William Renther	Salzburg	do		

United States from seed distributed by the Department.

ALABAMA.

Time of harvesting.	Character of soil.	Remarks by growers.	No. of beets.	Average weight.		Total solids.	Sucrose in—		Purity.
							Juice.	Beets.	
				Grams.	*Oz.*		*Per ct.*	*Per ct.*	
.....	.....	.....	....	.....	.....	9·31	6·2	5·9	66·7

COLORADO.

Oct. 25	.....	.....	....	535	19	.....	18·7	17·8	83·7
Sept. 22	Reddish coarse sand	.....	.....	.....	.....	19·33	17	16·2	88·1
Oct. 6	Sandy clay loam....	Irrigated land	2	360	12·5	19·67	14·9	14·2	75·7
...do	....do	Hail destroyed tops July 8.	2	325	11·5	21·67	17·4	16·5	80·2
...do	....do	....do	2	467	16·5	20·33	15·9	15·1	78·4
...do	....do	....do	2	226	8	19·23	14·6	13·9	76·1
...do	....do	....do	2	354	12·5	20·53	16·8	16	81·4
...do	....do	....do	2	339	12	16·50	11·4	10·8	69·1
Oct. 7	....do	....do	2	474	17	12·10	8·7	8·3	71·9
...do	....do	....do	2	1,160	41	13·61	7·5	7·1	55·1
.....	.....	.....	....	395	} Samples too small for analysis.				
.....	.....	.....	....	262					

IDAHO.

Oct. 10	Black loam	Beets frozen once....	1	1,797	63·5	14·70	11·4	10·8	77·5
Oct. 6	....do	.....	1	2,589	91·5	13·50	10·1	9·6	74·8

INDIANA.

Oct. 19	.....	.....	....	242	8·5	.....	13·1	12·4	81·5
Oct. 8	Gravelly clay.....	.....	2	283	10	16·66	12	11·4	71·9
.....	.....	.....	....	293	10·5	.....	8·1	7·7	67·1

IOWA.

Oct. 30	Sandy loam	Used for truck farm'g	....	165	5·5	.....	15·6	14·8	72·9
...do	....do	.....	....	220	7·5	.....	15·2	14·4	81·3
...do	....do	Used for truck farm'g	....	285	10	.....	13·3	12·6	74
.....	.....	Season dry	....	535	18·9	.....	14·8	14·1	81·3
Oct. 24	Sandy	.....	2	587	21	16·07	12·1	11·5	75·1
Nov. 6	Black prairie loam..	Season dry	....	915	32·3	.....	11	10·5	71

KANSAS.

Sept. 20	Black limestone	.....	....	.....	.....	20·56	15	14·3	72·8

LOUISIANA.

Oct. 2	Red sandy loam	Fertilized with stable manure.	....	.....	.....	11·57	7·8	7·4	67·2
Oct. 18	....do	....do	2	333	11·5	14·68	10·2	9·7	69·4

MICHIGAN.

Sept. 22	Black swamp muck.	Tile drainage; no fertilizer.	....	.....	.....	15·36	9·9	9·4	64·3
.....	.....	.....	....	835	29	.....	16·1	15·2	82·2
.....	.....	.....	....	1,565	55	.....	7·8	7·4	61·9

Table of analyses of beets grown in different parts of the United

MICHIGAN—Continued.

Serial No.	Name of grower.	Post-office.	County.	Variety.	Time of planting.
17263	J. H. Coon, care of McGraw & Co.	Portsmouth	Bay	Vilmorin's Imperial	May 20
17264	do	do	do	Kleinwanzlebener	do
17265	do	do	do	French sugar red top.	do
17266	do	do	do	Florimond Desprez	do
17267	do	do	do	Knauer's Imperial	do
17268	do	do	do	do	do
17269	Owen Hawkins	do	do	French sugar red top.	May 25
17270	do	do	do	Florimond Desprez	do
17271	do	do	do	Kleinwanzlebener	do
17272	do	do	do	Vilmorin's Imperial	do
17273	G. W. Green	do	do	French sugar red top.	June 4
17274	do	do	do	Knauer's Imperial	do
17275	do	do	do	Kleinwanzlebener	do
17276	do	do	do	Florimond Desprez	do
17277	do	do	do	Vilmorin's Imperial	do
17278	do	do	do	Vilmorin's Richest	do
17279	do	do	do	Dippe's Imperial	do
17280	Berth Bros	do	do	Kleinwanzlebener	May 29
17281	Robert Nivens	do	do	do	June 6
17282	Lobden	do	do	do	May 26
17283	John H. Potter	do	do	do	May 29
17284	Hopkins & Bartlett	do	do	do	May 21
17285	H. Lambrecht	do	do	do	June 3
17286	John Currion	do	do	Vilmorin's Richest	May 10
17287	C. B. Chatterfield farm	do	do	Kleinwanzlebener	May 21
17288	John Lunden	do	do	do	May 20
17289	H. P. Matts	do	do	Vilmorin's Imperial	May 19
17290	F. Fischer	do	do	Kleinwanzlebener	May 18
17291	Joseph H. Potter	do	do	Vilmorin's Imperial	May 29
17292	William Merritt	do	do	do	June 2
17293	J. Currion	do	do	Kleinwanzlebener	May 18
17294	J. Lunden	do	do	Vilmorin's Imperial	May 20
17295	A. B. Henry	do	do	Kleinwanzlebener	June 3
17296	Wm. Merritt	do	do	do	June 2
17297	H. Lambrecht	do	do	Vilmorin's Imperial	June 3
17298	H. P. Matts	do	do	Florimond Desprez	May 19
17299	Ed. Lambrecht	do	do	Kleinwanzlebener	May 26
17300	Bird Shuler	do	do	Dippe's Kleinwanzlebener.	June 18
17301	C. B. Chatterfield farm	do	do	Florimond Desprez	May 21
17302	Hopkins & Bartlett	do	do	French sugar red top.	do
17303	Berth Bros	do	do	Vilmorin's Imperial	May 29
17304	J. Currion	do	do	Dippe's Kleinwanzlebener.	May 10
17305	McGraw's farm	do	do	Kleinwanzlebener	June 10
17306	H. P. Matts	do	do	do	May 19
17307	Bird Shuler	do	do	do	June 18
17308	Robert Nivens	do	do	Florimond Desprez	June 6
17309	C. B. Chatterfield farm	do	do	Vilmorin's Imperial	do
17310	J. Currion	do	do	do	May 10
17311	Lewis Knight	do	do	Kleinwanzlebener	May 29

MINNESOTA.

8	Perry E. Reynolds	West Concord	Dodge	Knauer No. 1	May 27
128	Riley Mantor	Mantorville	do	Lemaire No. 2	May 16
171	do	do	do	do	do
74	John Buckley	Minneota	Lyon	Knauer	May 17

MONTANA.

185	Julius C. Martin	Evans	Cascade	Lemaire	May 12

States from seed distributed by the Department—Continued.

MICHIGAN—Continued.

Time of harvesting.	Character of soil.	Remarks by growers.	No. of beets.	Average weight.		Total solids.	Sucrose in—		Purity.
							Juice.	Beets.	
				Grams.	*Oz.*		*Per ct.*	*Per ct.*	
Nov. 2	Sandy loam		2	475	16·5	.....	13·1	12·4	77·5
...do	....do		2	490	17·3	.....	10	9·5	69
...do	....do		2	345	10·5	.....	13·8	13·1	79·8
...do	....do		2	450	16	.....	16	15·2	83·3
...do	....do		2	400	14	.....	15·8	15	85·4
...do	....do		2	405	14·5	.....	14·8	14·1	80
...do	....do		2	450	16	.....	13·5	12·8	82·3
...do	....do		2	480	16·9	.....	13·5	12·8	84·4
...do	....do		2	520	18·5	.....	15·1	14·3	86·3
...do	....do		2	435	15·2	.....	14·9	14·2	89·2
Nov. 4	....do		2	400	14	.....	14·6	13·9	85·4
...do	....do		2	355	12·5	.....	17·3	16·4	87·4
...do	....do		2	510	18	.....	14·4	13·7	84·7
...do	....do		2	515	17·8	.....	16	15·2	81·2
...do	....do		2	435	15	.....	16·3	15·5	85·3
...do	....do		2	425	15	.....	17·2	16·3	86·9
Nov. 6	....do		2	410	14·4	.....	14·9	14·2	83·2
Nov. 1	....do		2	464	16·4	.....	15	14·3	83·3
Oct. 25	....do		2	374	13·2	.....	14·6	13·9	81·6
Nov. 1	Clay loam	At Collins' farm	2	425	14·9	.....	13·7	13	88·4
Nov. 7	Sandy loam		2	485	17·1	.....	14·8	14·1	91·4
Nov. 1	....do		2	420	14·8	.....	13	12·3	79·3
Oct. 28	Clay loam		2	430	15·2	.....	13·5	12·8	82·3
Nov. 4	....do		2	310	10·9	.....	17	16·3	88·1
Nov. 1	....do		2	403	14·1	.....	16	15·2	87
Nov. 5	Sandy loam		2	416	14·7	.....	13·5	12·8	83·8
Nov. 4	....do		2	406	14·3	.....	15·6	14·8	84·3
Nov. 2	Loamy clay		2	404	14·3	.....	15·5	13·8	85·8
Nov. 7	Sandy loam		2	442	15·6	.....	13·7	13	83·5
Nov. 6	....do		2	444	15·7	.....	15	14·3	83·3
Nov. 9	Loamy clay		2	429	15·1	.....	12·7	12·1	85·8
Nov. 5	Sandy loam		2	367	12·9	.....	13	12·3	86·1
Nov. 6	....do		2	408	14·4	.....	11·7	11·1	80·7
...do	....do		2	529	18·5	.....	12·7	12·1	81·9
Oct. 28	Loamy clay		2	394	13·8	.....		Lost.	
Nov. 4	Sandy loam		2	428	15·1	.....	14·2	13·5	87.1
Nov. 3	....do		2	356	12·6	.....	16	15·2	86·3
Nov. 8	....do	Oxnard's seed	2	449	15·9	.....	15·8	15	86·8
Nov. 1	Loamy clay		2	449	15·8	.....		Lost.	
...do	Sandy loam		2	358	12·6	.....	15·4	14·6	85·1
...do	....do		2	330	11·6	.....		Lost.	
Nov. 4	Loamy clay		2	313	11	.....		Lost.	
...do	....do		2	375	13·2	.....	16·2	15·4	87·6
...do	Sandy loam		2	370	13	.....	15·3	14·5	85
Nov. 8	....do		2	360	12·7	.....	15·7	14·9	85·8
Oct. 25	....do		2	283	10	.....		Lost.	
...do	....do		2	460	16·2	.....	12·9	12·3	79·7
Nov. 7	....do		2	455	16·1	.....		Lost.	
Oct. 29	....do		2	431	15·2	.....	12·9	12·3	80·6

MINNESOTA.

Sept. 12	Black yellow subsoil	No fertilizer	....	.....	.....	16·93	13·2	12·5	78
Oct. 9	Black prairie loam	....do	2	2,702	95·5	10·86	6·8	6·5	62·6
...do	....do	....do	2	2,045	70·5	14·28	9·3	8·8	65
Sept. 25	Black sandy loam	....do	2	375	13	21·30	17·3	16·4	81·1

MONTANA.

Oct. 4	Black loam	.....	2	431	15	20·04	15	14·3	75

Table of analyses of beets grown in different parts of the United

NEBRASKA.

Serial No.	Name of grower.	Post-office.	County.	Variety.	Time of planting.
104	U. S. Experiment Station.	Schuyler	Colfax	Desprez No. 2	
105	do	do	do	do	
106	do	do	do	do	
163	Fred Maseberg	Thedford	Thomas	Vilmorin's Improved Imperial.	May 5

NORTH CAROLINA.

3	E. S. Shiver	Rocky Point	Purdee		

NORTH DAKOTA.

167	T. N. Orum	Lisbon	Ransom		May 19

PENNSYLVANIA.

45	J. A. McGranahan	Kennard	Mercer	Kleinwanzlebener	May 30

VIRGINIA.

17329	O. K. Lapham & Co	Staunton	Augusta		
17330	do	do	do		
17331	do	do	do		
17332	do	do	do		
17333	do	do	do		
17334	do	do	do		
17335	do	do	do		

WASHINGTON.

31	J. O'Keefe	Asotin	Asotin		May 10
32	do	do	do		May 15
156	do	do	do	Kleinwanzlebener	May 12
157	do	do	do	do	do
129	M. Pietozicki	Dayton	Columbia		May 11
165	H. T. Hudson	Waterville	Douglas	Kleinwanzlebener	Apr. 4
166	do	do	do	Dippe's Kleinwanzlebener.	Apr. 16
17318	Geo. W. Elliott	Ellensburg	Kittitas		June 5
17319	Harry Walden	do	do		May 26
34	David T. Hain	Latah	Spokane		May 25
36	B. F. Copler	do	do		May 18
37	Roncisco J. Davis	do	do		June 1
38	Geo. W. Copelan	do	do		May 20
164	Chest. Gifford	do	do		do
41	E. H. Morrison	Fairfield	do	Vilmorin's Richest	June 4
42	do	do	do	Florimond Desprez	do
43	do	do	do	Knauer's Imperial	June 3
44	do	do	do	Kleinwanzlebener	June 4
183	do	do	do	do	
184	do	do	do	Knauer's Imperial	
190	do	do	do	Vilmorin's Richest	
191	do	do	do	Florimond Desprez	

States from seed distributed by the Department—Continued.

NEBRASKA.

Time of harvesting.	Character of soil.	Remarks by growers.	No. of beets.	Average weight.		Total solids.	Sucrose in—		Purity.
							Juice.	Beets.	
				Grams.	*Oz.*		*Per ct.*	*Per ct.*	
.....	.....	.....	2	552	19·5	14·09	9·3	8·8	65·9
.....	.....	.....	2	312	11	13·69	8·5	8·1	62·1
.....	.....	.....	2	418	15	15·19	10·7	10·2	70·4
Oct. 6	Black sandy loam ..	.....	2	665	23·5	17·40	14	13·3	80·5

NORTH CAROLINA.

.....	.....	.....	....	.....	.....	8·35	4·4	4·1	52·1

NORTH DAKOTA.

Oct. 19	Black sandy loam ..	Last crop Mangel-wurzel.	2	615	27	18·19	14·7	14	80·7

PENNSYLVANIA.

Oct. 4	Black, sandy	Previously used bone fertilizer.	....	.....	.....	14·67	11·6	11	78·9

VIRGINIA.

.....	.....	Smart's field	3	480	17	.....	13·8	13·1	80·1
.....	.....	Folly mills	3	470	17·3	.....	15·2	14·4	87·7
.....	.....	Lagrange farm.....	4	286	14·4	.....	11·9	11·3	82·7
.....	.....	Folly mills	....	.....	.....	.....	14·5	13·7	82·4
.....	.....	O. K. Lapham farm ..	....	.....	.....	.....	15·5	14·7	81·6
.....	.....	Smart farm	....	.....	.....	.....	15·2	14·3	81·5
.....	.....	Harrison farm	....	.....	.....	.....	17·1	16·3	85

WASHINGTON.

Sept. 15	Gray loam	Irrigated	....	.....	.....	15·46	11·8	11·2	78·1
Sept. 5	Sandy loam.....	Raised on farm of L. M. Troyer.	....	.....	.....	19·86	16·4	15·6	82·4
Oct. 6	Gray loam, some alkali.	Irrigated every two weeks.	1	948	33·5	17·47	13·1	12·4	74·8
...do	....do	....do	1	1,274	45	15·67	11·2	10·6	71·3
Oct. 2	Sandy bottom land..	Cultivated twice	2	906	32	12·46	8·3	7·9	66·4
Oct. 10	Decomposed volcanic rock.	.....	1	396	14	.....	14·8	14·1	.....
...do	....do	.....	1	283	10	.....	15·7	14·9	.....
Oct. 25	.....	.....	....	613	21·5	.....	17·4	16·5	86·6
Nov. 9	Black sandy loam ..	.....	....	345	12	.....	16·5	15·7	75·8
Sept. 26	Black loam	No cultivation	....	.....	.....	16·41	13·6	12·9	83
Sept. 25	.....do	.....	....	.....	.....	15·81	12	11·4	76
Sept. 26	.....do	.....	....	.....	.....	17·91	14·6	13·8	82·1
Sept. 20	Loam	.....	....	.....	.....	18·11	14·8	13·9	81·7
Oct. 10	Prairie loam	.....	2	1,967	69·5	16·50	11·8	11·2	71·5
Sept. 28	Black prairie loam..	.....	....	.....	.....	18·60	15	14·3	80·7
...do	....do	Natural drainage	....	.....	.....	17·11	12·4	11·8	72·5
...do	....do	....do	....	.....	.....	19·60	15·3	14·5	78·1
...do	....do	....do	....	.....	.....	19·10	14·9	14·2	77·9
Oct. 15	.....	.....	2	1,076	38	17·05	11·9	11·3	70
...do	.....	.....	2	942	33	17·94	13·7	13	76
...do	.....	.....	2	573	20	18·15	14	13·3	76·9
...do	.....	.....	2	672	23	13·96	9·6	9·1	68·5

Table of analyses of beets grown in different parts of the United

WASHINGTON—Continued.

Serial No.	Name of grower.	Post-office.	County.	Variety.	Time of planting.
192	E. H. Morrison	Fairfield	Spokane	Kleinwanzlebener	
193	do	do	do	Florimond Desprez	
194	do	do	do	Kleinwanzlebener	
195	do	do	do	do	
196	do	do	do	Vilmoni Amelioree	
197	do	do	do	Kleinwanzlebener	May 29
198	do	do	do	Vilmoni Amelioreo	do
199	do	do	do	Florimond Desprez	do
62	C. R. Burns	Spokane	do	Kleinwanzlebener	May 16
178	A. Lefevre	Medical Lake	do	Knauer's Imperial	do
182	Henry Hashagen	do	do	do	May 15
55	D. F. Lucas	Chewelah	Stevens	Kleinwanzlebener	May 6
181	Dr. N. G. Blalock	Walla Walla	Walla Walla		Apr. 23
6	F. A. Craig	Tekoa	Whitman	do	May 16
7	William Button	do	do	do	May 10
11	O. N. Sparks	do	do	do	May 2
12	Thomas Hill	do	do	do	May 1
15	D. C. Sparks	do	do	do	May 9
16	William Hoar	do	do	do	May 15
17	Aiden Page	do	do	do	May 2
18	D. A. Hoffmann	do	do	do	June 1
19	C. R. Sparks	do	do	do	May 20
20	Henry Mustoe	do	do	do	May 5
21	B. E. Wilson	do	do	do	May 16
23	J. A. Sanders	do	do	do	May 30
24	K. T. Sparks	do	do	do	May 28
25	George Erwin	do	do	do	May 30
26	J. Sparks	do	do	do	June 1
27	John Erwin, sr	do	do	do	May 30
28	William Erwin	do	do	do	June 2
29	John Erwin	do	do	do	June 3
30	John McDonald	do	do	do	June 1
51	J. Ritzloff	do	do	do	May 20
52	A. B. Luper	do	do	do	May 29
53	James Lindsay	do	do	do	May 15
54	Daniel Johnson	do	do	do	May 27
65	Henry Westermann	do	do	do	May 22
66	G. T. Smith	do	do	do	May 12
67	Wm. Hart	do	do	do	May 19
68	S. G. Jamison	do	do	do	May 30
69	Thomas Warwick	do	do	do	May 2
70	Dan Calland	do	do	do	May 16
71	K. Tylor	do	do	do	May 3
72	William Warwick	do	do	do	May 9
73	A. J. Sharrod	do	do	do	May 20
75	E. J. Moak	do	do	do	May 29
76	David Jones	do	do	do	do
77	H. H. Noble	do	do	do	May 9
78	Joseph Bertholff	do	do	do	May 28
79	Wm. McBride	do	do	do	May 27
80	Gus. Willoughby	do	do	do	May 26
81	Wm. Franklin	do	do	do	June 1
82	John Westermann	do	do	do	May 1
83	David Bertholf	do	do	do	May 27
84	William Sennott	do	do	do	June 2
85	James Carbery	do	do	do	May 11
86	James Bertholf	do	do	do	May 30
97	Peter Campbell	do	do	do	May 28

States from seed distributed by the Department—Continued.

WASHINGTON—Continued.

Time of harvesting.	Character of soil.	Remarks by growers.	No. of beets.	Average weight.		Total solids.	Sucrose in—		Purity.
							Juice.	Beets.	
				Grams.	*Oz.*		*Per ct.*	*Per ct.*	
Oct. 15	.....	.....	2	1,054	37	15·16	10·8	10·3	71·1
...do	.....	.....	2	290	10	19·54	16·8	16	86·2
...do	.....	.....	2	630	22	17·85	13·9	13·2	77·7
...do	.....	.....	2	825	9·5	19·54	15·5	14·7	79 5
...do	.....	.....	2	191	7	20·14	17·1	16·2	85
...do	Black prairie loam..	Not drained; hill land.	2	226	8	22·03	18·7	17·8	84·9
...do	Black loam.....	.....	2	177	6	19·24	16·4	15·6	85 4
...do	....do	.....	2	488	17	17·45	13·8	13·1	78·8
Oct. 4	....do	Yellow subsoil.....	2	665	23·5	17·67	13·7	13	77·4
Oct. 16	Black sandy soil....	No fertilizer in cultivation 16 years.	2	566	20	19·88	16·4	15·6	83·3
Oct. 17	Black prairie loam..	.....	2	1,245	44	19·24	14·8	14·1	77·1
Sept. 25	Gray loam, clay subsoil.	.....	....	.....	.....	16·86	13	12·4	77
Oct. 14	Light volcanic.....	Irrigated occasionally.	2	1,860	65·5	14·31	10·9	10·4	76·2
Sept. 7	Volcanic black loam.	No rain nor irrigation	....	.....	.....	15·17	11·1	10·6	73·2
Sept. 12	Black prairie loam..	No fertilizer	....	.....	.....	14·63	9·6	9·1	65·6
Sept. 18	Deep black loam	.....	....	.....	.....	20·43	10·8	10·3	52·9
...do	Volcanic black loam.	Cultivated once.....	....	.....	.....	17·53	8·3	7·9	47·3
...do	Deep black loam....	No fertilizer	....	.....	.....	18·13	9·9	9·4	54·6
Sept. 21	Sandy and dry.....	.....	....	.....	.....	18·63	14	13·3	75·3
...do	Volcanic black loam.	.....	....	.....	.....	16·43	11·8	11·2	72
...do	Black loose loam....	On north hillside	....	.....	.....	16·53	11·5	10·9	69 7
...do	Volcanic loam	No fertilizer	....	.....	.....	17·83	13·5	12·8	75·9
Sept. 22	Black loam	Bottom land	....	.....	.....	16·63	11·4	10·8	68·6
Sept. 21	Black loam, volcanic.	....do	....	.....	.....	16·73	12·5	11·9	74·9
Sept. 24	....do	No fertilizer	....	.....	.....	16·66	11·3	10·7	66·7
Sept. 23	Gravelly loam	....do	....	.....	.....	14·36	9·3	8·8	64·5
...do	Black sandy loam ..	Subsoil clay	....	.....	.....	14·56	9·9	9·4	67·8
...do	....do	No fertilizer.....	....	.....	.....	16·96	12·2	11·6	71·7
...do	Deep black clay	Sandy	....	.....	.....	18·16	12·5	11·9	68·6
...do	Black sandy loam...	Pine land	....	.....	.....	17·56	11·7	11·1	66·5
...do	Black loam, volcanic.	No fertilizer.....	....	.....	.....	18·36	13·7	13	74·4
...do	Black volcanic loam.	.....	....	.....	.....	19·06	15·5	14·7	81·5
Oct. 1	....do	No fertilizer.....	....	.....	.....	17·76	13·3	12·6	74·7
...do	....do	....do	....	.....	.....	18·76	14·5	13·8	77·1
Oct. 2	Deep black loam....	South hillside	....	.....	.....	16·16	11·5	10·9	71
Oct. 1	Deep black pine land.	.....	....	.....	.....	19·66	15	14·3	76·2
Oct. 5	Deep black loam....	South hillside, no fertilizer.	1	1,104	47.	19·68	15	14·3	77·7
...do	Heavy loam	No fertilizer	1	665	23·5	16·58	11·5	10·9	69·2
...do	Deep black loam....	Bottom land	1	1,457	51·5	18·88	13·6	12·9	71·9
...do	Black volcanic loam.	No fertilizer	1	1,373	48·5	15·38	10·7	10·2	66·4
...do	Black loam table-land.	.....	1	976	34·5	19·19	16	15·2	83·4
...do	Black clay loam	Volcanic formation ..	1	1,373	48·5	15·28	10·6	10·1	69·3
...do	Black loam, north slope.	.....	1	2,321	82	13·77	8·9	8·5	64·5
...do	....do	No fertilizer	1	877	31	16·39	12	11·4	73·2
...do	Volcanic loam	....do	1	1,358	48	16·59	12·5	11·9	75·3
Oct. 6	Black prairie land..	No fertilizer, volcanic.	1	863	30·5	17·84	12·3	11·7	69·1
...do	Black volcanic loam.	High table-land.....	1	368	13	18·91	13·3	12·6	70·4
Oct. 5	....do	High, dry pine land .	1	382	13·5	17·54	11·7	11·1	66·8
Oct. 6	Light pine land.....	No fertilizer	1	736	26	17·74	12·3	11·7	69·5
...do	Black prairie loam .	Volcanic formation ..	1	523	18·5	17·54	13·2	12·5	75·4
.....	Light sandy loam ..	.....	1	1,259	44·5	16·64	11·4	10·8	68·6
Oct. 6	Sandy loam, pine land.	.....	1	495	17·5	16·47	11	10·5	66·7
Oct. 5	Black volcanic loam.	No fertilizer nor irrigation.	1	906	32	14·37	9	8·6	62·5
Oct. 6	Light sandy soil....	.....	1	792	28	15·97	10	9·5	62·5
...do	Black prairie land ..	No fertilizer	1	509	18	14·53	9·1	8·6	62·8
Oct. 5	Black loose loam....	.....	1	1,641	58	14·77	9·8	9·3	66·2
Oct. 6	Light pine table-land.	No fertilizer	1	1,203	42·5	14·97	10	9·5	66·7
Oct. 5	Deep black loam....	No fertilizer nor irrigation.	1	1,019	36	16·96	11·9	11·3	70

Table of analyses of beets grown in different parts of the United

WASHINGTON—Continued.

Serial No.	Name of grower.	Post-office.	County.	Variety.	Time of planting.
98	James Campbell	Tekoa	Whitman	Kleinwanzlebener	May 19
107	John Schon	do	do	do	May 30
108	John Fenn	do	do	do	do
109	Ben Carl	do	do	do	May 18
110	N. B. Welton	do	do	do	May 28
111	Joab Robertson	do	do	do	May 31
112	George Prettiman	do	do	do	May 28
113	J. Romine	do	do	do	May 21
114	Grant Palmer	do	do	do	May 26
115	F. S. Cornell	do	do	do	May 23
116	D. W. Bridgeman	do	do	do	May 27
117	Knute Ericson	do	do	do	June 1
118	A. B. Walker	do	do	do	May 24
119	A. B. Willard	do	do	do	May 28
120	R. T. Smiley	do	do	do	May 24
121	J. A. Gunn	do	do	do	May 28
122	William Breen	do	do	do	May 29
123	W. B. Smith	do	do	do	May 31
124	John Conger	do	do	do	May 23
125	John England	do	do	do	May 19
126	A. N. Hoffman	do	do	do	May 24
130	G. R. Winslow	do	do	do	May 18
131	G. T. Huffman	do	do	do	May 29
132	Cornelius Kole	do	do	do	May 20
133	O. R. McDonald	do	do	do	May 30
134	William Click	do	do	do	June 1
135	J. B. Sampter	do	do	do	May 19
136	John Stevens	do	do	do	May 30
137	A. Goddard	do	do	do	do
138	A. J. Bancroft	do	do	do	May 23
139	H. D. Kay	do	do	do	May 26
140	Austin Footer	do	do	do	May 30
141	Ed. Trammill	do	do	do	May 24
142	George Steen	do	do	do	May 29
143	Alexander Tomblinson	do	do	do	May 28
144	J. S. Young	do	do	do	May 22
145	Matt Fountain	do	do	do	May 20
146	J. T. Whaley	do	do	do	May 21
147	O. C. Daley	do	do	do	do
148	James Storey	do	do	do	May 28
149	Thos. Balkow	do	do	do	May 20
150	J. Bayles	do	do	do	May 25
151	H. Goddard	do	do	do	May 23
152	Henry Howard	do	do	do	May 28
153	Chas. H. Strope	do	do	do	May 26
154	C. Strope	do	do	do	May 20
155	James Tyson	do	do	do	May 28
13	F. E. Decringhoff	Uniontown	do	Elite No. 2	May 19
168	do	do	do	Desprez	do
169	do	do	do	Elite No. 2	do
170	do	do	do	Dippe	do
172	do	do	do	Knauer	do
173	do	do	do	Lemaire	do
174	do	do	do	Desprez No. 2	do
176	do	do	do	Kleinwanzlebener	do
177	do	do	do	Lemaire	do
179	do	do	do	Elite No. 2	do
103	Sardis I. Brockway	Rosalia	do	Elite	May 13
95	Geo. P. Tolton	do	do	German sugar beet	May 10
96	do	do	do	do	Apr. 20
158	Evan Peddicord	Palouse	do		June 12
17322*a*	F. M. Jeffries	do	do		
17322*b*	do	do	do		
17322*c*	do	do	do		
17325	C. J. Rumens	do	do		June 3
17259	Geo. Ruedy	Colfax	do	Kleinwanzlebener	
17260	do	do	do	Vilmorin's Richest	
17261	do	do	do	Knauer's Imperial	
17320	J. T. Edge	Palouse	do		June 1

States from seed distributed by the Department—Continued.

WASHINGTON—Continued.

Time of harvesting.	Character of soil.	Remarks by growers.	No. of beets.	Average weight.		Total solids.	Sucrose in—		Purity.
							Juice.	Beets.	
				Grams.	*Oz.*		*Per ct.*	*Per ct.*	
Oct. 5	Black volcanic loam.	No fertilizer nor irrigation.	1	877	31	16·76	11·8	11·2	70·2
Oct. 9	Grass lands	Land cultivated 9 years.	1	976	34·5	17·92	14·3	13·6	79·9
Oct. 6	Black loose loam		1	877	31	16·01	11·5	10 9	71·9
Oct. 9	Black prairie land	No cultivation	1	283	10		11·4	10·8	
...do	Prairie land	In wheat 9 years	1	608	21·5	17·13	11·6	11	67·9
...do	Prairie land, moist	No cultivation	1	495	17·5	15·93	11·2	10·6	70·4
...do	Black loam	Land cultivated 13 years.	1	481	17	15·23	9·7	9·2	63·8
...do	...do	In wheat 3 years	1	325	11·5	16 96	11·8	11·2	69·4
...do	Black fertile loam	Ground very hard	1	538	19	17·86	13·2	12·5	74·2
...do	Prairie land	Beets not cultivated.	1	651	23		16·4	15·6	
...do	Black prairie loam		1	325	11·5	17·06	11	10·5	62·2
...do	Deep black prairie soil.	No cultivation	1	382	13·5	18·53	13·9	13·2	75·1
...do	Cultivated prairie	Ground very hard	1	906	32	16·94	13·6	12·9	80·5
...do	Black prairie loam	Wheat 8 years	1	509	18		14·7	14	
...do	...do	Beets cultivated once	1	849	30	17·70	14·5	13·8	81·9
...do	Prairie land		1	722	25·5	16·51	12·8	12·2	77·7
...do	Black volcanic soil	No cultivation	1	156	5·5		13	12·4	
...do	Prairie land		1	396	14	16·54	12·6	12	76·4
...do	Rolling prairie land		1	184	6·5		16·4	15·6	
...do	Bunch grass land	Cultivated once	1	255	9		15·2	14·4	
...do	Prairie land	In wheat 6 years	1	396	14		15·1	14·3	
...do	Loose prairie land	No cultivation	1	1,571	55·5	16·16	12	11·4	74
...do	Prairie land	In wheat 12 years	1	651	23	17·48	13·7	13	78·2
...do	Deep black loam	Beets grew slowly	1	170	6		16·3	15·5	
...do	...do	Cultivated once; ground hard.	1	198	7		16·6	15·8	
...do	Bunch grass land	No cultivation	1	310	11		14·6	13·9	
...do	Black volcanic loam	...do	1	449	15·5	16·46	14·8	14·1	89·7
...do	Rolling prairie land	...do	1	310	11		12·6	12	
Oct. 10	Black loam, volcanic	No fertilizer	1	1,259	44·5	15·17	10	9·5	65·8
...do	Prairie land	Wheat for 5 years	1	1,090	38·5	13·57	9·4	8·9	69·1
...do	Black volcanic soil		1	863	30·5	13·97	9·8	9·3	70
...do	Black prairie loam		1	1,401	49·5	13·67	8·5	8·1	62·1
...do	Loose prairie land	Cultivated twice	1	538	19	14·07	8	7·6	56·7
...do	Black prairie loam		1	736	26	15·07	11	10·5	72·8
...do	...do		1	835	29·5	14·97	11·3	10·7	75·4
...do	Prairie land	Not subsoiled	1	920	32·5	16·47	11·6	11	70·3
...do	Black clay loam	No fertilizer	1	736	26	16·27	11·5	10·9	70·5
...do	Prairie land		1	552	19·5	13·47	9·6	9·1	71·1
...do	...do		1	821	29	15·17	11·9	11·3	78·3
...do	Black volcanic loam		1	1,090	38·5	15·47	10·7	10·2	69
...do	Mellow prairie soil	Cultivated 3 times	1	538	19	16·67	12·4	11·8	74·3
...do	Prairie loam		1	722	25·5	16·37	11·4	10·8	69·5
...do	Fine prairie land		1	651	23	15·77	10·6	10·1	67·1
...do	Volcanic loam		1	467	16·5	16·97	13·4	12·7	78·8
...do	Black loam, clay subsoil.		1	368	13	19·27	13·3	12·6	68·9
...do	Black loam	In wheat 5 years	1	495	17·5	18·77	15·4	14·6	81·9
...do	...do		1	580	20·5	14·27	10·3	9·8	72
Sept. 18	Black prairie soil	No fertilizer				20·58	13·5	12·8	65·6
Oct. 15	...do		2	764	27	17·49	13·1	12·4	74·8
...do	Yellow prairie loam	No fertilizer	2	538	19	18·29	14·8	14·1	80·8
...do	Black prairie soil	...do	2	708	25	18·59	14·5	13·8	78
...do	...do	...do	2	807	28·5	17·87	13·4	12·7	74·9
...do	Black bottom land	...do	2	884	31	16·98	13·4	12·7	78·8
...do	Yellow prairie loam	...do	2	779	27·5	17·87	14·5	13·8	81·1
...do	Black prairie soil		2	729	25·5	18·08	14·3	13·6	78·9
...do	Yellow prairie loam	No fertilizer	2	820	29	16·79	13·2	12·5	78·5
...do	Black prairie soil	...do	2	580	20·5	18·98	15·9	15·1	83·6
Oct. 6	Black prairie loam	...do	2	2,030	72	14·86	9·3	8·9	62·4
Oct. 1	Black soil		1	778	27·5	20·56	15·9	15·1	77·1
...do	Black loam		1	1,160	41	14·56	8·3	7·9	56·9
Oct. 6	Black mould, yellow clay subsoil.		2	1,479	52	14·87	10·2	9·7	68·4
Nov. 5	Side hill			1,010	35·6		12	11·4	67
				1,122	46·5		13·7	13	72·1
				1,180	41·5		12·2	11·6	68·3
Nov. 16	Black soil			827	29		14·6	13·9	76·8
				785	27·5		14·7	14	81·2
				630	22		13·7	13	75·3
				850	30		12·9	12·3	79
Nov. 8		Sod turned in April		990	35		14·5	13·8	78·4

Table of analyses of beets grown in different parts of the United

WASHINGTON—Continued.

Serial No.	Name of grower.	Post-office.	County.	Varicty.	Time of planting.
17321	D. W. Tweitmeyer	Palouse	Whitman		May 20
17326	H. M. Haskel, by H. W. Lichty & Co.	do	do		1st week in June.
60	J. M. Stout	Yakima	Yakima	Kleinwanzlebener	Apr. 26
160	do	do	do	do	do

WYOMING.

56	F. J. Niswander	Laramie	Albany	Vilmorin's La plus Riche.	May 13
57	do	do	do	Knauer	do
58	do	do	do	Dippe's Kleinwanzlebener.	do
17251	Alfred Bridger	Sibylee	do	Vilmorin's Richest	June 2
33	J. D. Parker	Saratoga	Carbon	Kleinwanzlebener Imperial.	May 10
35	do	do	do	Improved Bulteau	do
63	do	do	do	Vilmorin's Richest	June 3
64	do	do	do	Improve dKleinwanzlebener.	May 9
17255	do	do	do	Vilmorin's Richest	
17256	do	do	do	Improved Bulteau-Desprez.	
47	Sundance Expt. Farm	Sundance	Crook	Dippe's Kleinwanzlebener.	May 18
48	do	do	do	Vilmorin's Richest	do
49	do	do	do	Kleinwanzlebener	do
50	do	do	do	Improved Bulteau-Desprez.	do
186	do	do	do	Vilmorin's Richest	May 17
187	do	do	do	Improved Bulteau-Desprez.	do
188	do	do	do	Improved Kleinwanzlebener.	May 18
189	do	do	do	Dippe's Kleinwanzlebener.	May 17
100	J. S. Meyer (Lander Experiment Station).	Lander	Fremont	Vilmorin's Richest	May 5
101	do	do	do	Knauer's Imperial	do
102	do	do	do	Dippe's Kleinwanzlebener.	do
159	do	do	do	Improved Bulteau	May 10
17249	do	do	do	do	do
39	M. R. Johnson	Whiteland	Laramie	Vilmorin's Richest	May 8
40	do	do	do	Knauer's Imperial	do
17312	do	do	do	Kleinwanzlebener	Apr. 24
17315	do	do	do	Bulteau	Apr. 25
17316	do	do	do	Vilmorin's Richest	do
2	John F. Lewis	Sheridan	Sheridan	Improved Bulteau	May 8
4	do	do	do	Desprez	do
5	do	do	do	Kleinwanzlebener	do
9	do	do	do	Desprez Bulteau	do
10	do	do	do	Kleinwanzlebener	do
127	John Astle	Afton	Uinta	Desprez No. 2	May 20
16750	Mark Manley	Mountain View	do	Kleinwanzlebener	May 10

States from seed distributed by the Department—Continued.

WASHINGTON—Continued.

Time of harvesting.	Character of soil.	Remarks by growers.	No. of beets.	Average weight.		Total solids.	Sucrose in—		Purity.
							Juice.	Beets.	
				Grams.	*Oz.*		*Per ct.*	*Per ct.*	
Nov. 7	Black, subsoil clay			1.254	44		13·4	12·7	77·5
1st week in Nov.	Black loam			1.126	39·5		14·1	13·4	73·8
Oct. 2	Gray sandy loam, some alkali.	No fertilizer	1	877	31	20·08	17·8	16·9	88·5
Oct. 13	Gray sandy loam, considerable alkali.		2	524	18·5	17·50	15·8	15	90·2

WYOMING.

Oct. 3	Gravel loam	Irrigated by furrow irrigation.				17·52	13·8	13·1	78·8
...do	...do	...do				16·96	12·9	12·3	75·9
...do	...do	...do				17·36	13·2	12·5	75·9
Oct. 12				530	19		16·6	15·7	70·1
Sept. 25	Light sandy clay	Irrigated 3 times				20·60	16·8	16	81·5
...do	...do	Flooded 3 times				21·10	17·7	16·3	83·9
Oct. 6	...do	Irrigated 3 times	1	1,344	47·5	18·64	15·8	15	85
...do	...do	...do	1	1,330	47	19·68	16·7	15·9	84·8
Oct. 16	Sandy loam	In culture 3 years; irrigated.		310	11		22·5	21·4	86·1
...do	...do	...do		347	12		21	20·1	82·7
Sept. 25	Decomposed reddish gypsum.					19·50	14·1	13·4	72·3
...do	...do					21·77	15·7	14·9	72
...do	...do					23·66	18	17·1	76
...do	...do			Too small for analysis.					
Oct. 14	...do		2	297	10·5	22·92	17·8	16·9	87·8
...do	...do		2	226	8	24·21	17·5	16·6	72·3
...do	...do		2	389	13·5	21·33	16·2	15·4	76
...do	...do		2	382	13·5	19·74	14·5	13·8	73·7
Oct. 3	Red sandy loam	Irrigated 3 times	3	377	13	20·86	16·2	15·4	77·4
...do	...do	...do	3	481	17	20·26	16·4	15·6	80·9
...do	...do	...do	3	406	14	20·16	15·9	15·1	78·7
Oct. 13	Black sandy loam	Irrigated twice	4	810	38·5	19	15·8	15	83·1
...do				657	23·5		15·7	14·9	85·4
Sept. 25	Sandy loam	Irrigated 7 times; no fertilizer.				21·40	18·6	17·7	86·9
...do	...do	...do				20·90	17·8	16·9	85·1
Oct. 4	Red clay loam			293	10		22·3	21·2	86·4
Oct. 5	...do	Season rather dry		263	9		22·9	21·8	89·1
...do	...do			239	8·5		22·7	21·6	86·1
Aug. 8	Black loam, with clay.	Irrigated 3 times				17·70	13·8	13	78
Sept. 7	...do	Irrigated 4 times				20·74	17·9	17	86·3
...do	...do	...do				19·98	17·2	16·3	86·1
...do	...do	...do				21·94	18	17·1	82
...do	...do	...do				22·44	17·7	16·8	78·9
Oct. 1	Brown gravel loam	...do	2	594	21	16·69	13·6	12·9	81·5
Oct 2	Sandy loam	...do		575	20		13·9	13·1	72·4

A LIMITED DISTRIBUTION OF HIGH-GRADE SEEDS.

It is not believed that further experiment with the promiscuous distribution of seed will be of any practical benefit. Nevertheless, there is a large number of farmers applying each year for samples of seed, and incidentally some good can be done by supplying them with what they need. It is not necessary to enter into an argument here that the farmer will not be able on his own motion to secure beet seed of high grade. He can not be sure that the sugar-beet seed offered by dealers is anything more than the seed of the common beet; he does not know the address of the growers of beet seed of established reputation; even if he did, the cost and trouble of securing 2 or 3 pounds from abroad would be so great as to deter him from making the attempt. It seems, therefore, proper that as long as the Department is engaged in the distribution of seeds, it should send to those who inquire for them small samples of the highest grade beet seed which can be produced. While most of the samples will be productive of no great good, yet now and then one may reach a locality where it will excite interest, and possibly do much toward the future development of the industry. In addition to this it must not be forgotten that the cost of sending out a few thousand packages of beet seed is very small, and the chemical analyses are secured without expending a single dollar over the usual cost of conducting the laboratory. If the farmers receiving these gifts of the Department would learn the single lesson of appreciating the scientific agriculture which has made the sugar beet possible, it would be an ample repayment of the whole cost of distribution.

RELATION OF IRRIGATION TO SUGAR-BEET CULTURE.

In former reports attention has been called to the probable practical value of irrigated lands for the production of sugar beets. The high fixed charges which must necessarily attach to all irrigated lands render it imperative that some crop should be grown capable of intensive culture and of yielding large financial returns. There is no crop which offers so many advantages of this kind as the sugar beet. The growth of potatoes or vegetables for home market, or of any crop of this kind usually produced by intensive culture, must necessarily be restricted to a limited area, but the comparatively unlimited expansiveness of the market for sugar renders it possible to devote practically all of the irrigated lands which are likely to be recovered in many years to the production of the sugar beet.

EXPERIMENTS AT GRAND JUNCTION, COLO.

An interesting report of the growth of the sugar beet on irrigated land has been received from the Mitchell Drug Company, of Grand Junction, Colo. The report is accompanied by the following letter from Mr. C. E. Mitchell:

I take the liberty to forward you the tabulated results of my experiments with sugar beets in this valley during the past season. The analyses were all made by the

Lehi-Utah Beet Sugar Factory and the three carloads sold were bought by them. The yield where any sort of care had been taken of the crop has averaged 15 tons; beets were planted in rows 24 inches apart; cost of crop loaded on car about $45 per acre. There seems to be no difference in results when crop is rightly handled, from seed sown on heavy adobe soil or in the best sandy loam. All our crops, as the weather report shows, are dependent entirely on irrigation, and absolutely under the farmer's control in this respect. I am laboring with a view to getting capital to establish a plant here. I think I have all necessary points as regards cheap fuel, lime rock, etc., fully covered, and can show conclusively how money in a plant here can be made to pay good interest on capital invested. I have a theory that having the growth of the plant under our control and the large number of clear days and even temperature we have from August 10 to November 15, we have an exceptional climate for producing a beet rich in sugar and high in purity. Shall be glad to furnish you with any information as to my work that I can, and to receive suggestions from you. The seed used was the white variety and obtained from the Lehi factory.

METEOROLOGICAL STATISTICS.

Following is a summary of the weather data in Grand Junction, Colo., during the year:

December, 1892.

	Inches.
Total precipitation, snow fall	1¼
Mean temperature	29
Clear days	8
Fair days	15
Cloudy days	8

January, 1893.

Total precipitation, snow fall	2½
Mean temperature	28·76
Clear days	22
Cloudy days	7
Fair days	2

February, 1893.

Total precipitation, snow fall	18¾
Mean temperature	32·8
Clear days	11
Fair days	7
Cloudy days	10

March, 1893.

Total precipitation, snow fall	3½
Total precipitation, rainfall	0·58
Mean temperature	41·2
Clear days	15
Cloudy days	12
Fair days	4

April, 1893.

Total precipitation	0·3
Mean temperature	51·05
Clear days	8
Cloudy days	11
Fair days	11

May, 1893.

	Inches.
Total precipitation	0·79
Mean temperature	60·8
Clear days	22
Cloudy days	2
Fair days	7

June, 1893.

Total precipitation	0·09
Mean temperature	72·3
Cloudy days	5
Clear days	24
Fair days	1

July, 1893.

Total precipitation	0·11
Mean temperature	78·3
Cloudy days	4
Clear days	22
Fair days	5

August, 1893.

Total precipitation	0·89
Mean temperature	74·3
Cloudy days	4
Fair days	8
Clear days	19

September, 1893.

Total precipitation	0·22
Mean temperature	66·2
Cloudy days	1
Clear days	29

October, 1893.

	Inches.
Total precipitation	0·8
Mean temperature	52·8
Cloudy days	2
Clear days	22
Fair days	7

November, 1893.

Total precipitation:	Inches.
Snow fall	5½
Rainfall	0·25
Clear days	23
Fair days	4
Cloudy days	3
Mean temperature	37·2

ANALYSES OF BEETS GROWN ON DIFFERENT SOILS.

Sugar beets were grown by the various farmers in the neighborhood of Grand Valley, and the report of the analyses of samples from each of these is given in the following table:

Results of experiments in the growth of sugar beets in Grand Valley, Colorado.

[About 50 acres were under cultivation, embracing a variety of soils.]

Name.	Planted.	First sampling.	Polar.	Purity.	Second sampling.	Polar.	Purity.
			Per cent.	*Per cent.*		*Per cent.*	*Per cent.*
Currie	Apr. 20	Sept. 27	12·2	73·5	Oct. 25	12·7	76·1
P. A. Rice	...do	...do	13	76·5	...do	13·6	78·6
A. A. Miller	...do	Sept. 19	10·2	72·3	...do	14·1	81·8
Indian School	Apr. 26				Oct. 19	16	84
A. J. McCune	Apr. 22	Sept. 27	10	67·1	Oct. 25	11·1	70·9
Ed Bravier	...do	...do	13·4	76·1	Oct. 19	15·7	85
C. W. Steele	Apr. 26						
Eugene Allison	Apr. 28				Oct. 25	16·5	81·3
Ovid Turnill	Apr. 29				...do	13·3	78·2
W. H. Benkit	May 3	Sept. 27	12	74·1	Nov. 4	14	78·3
Porter	...do	Oct. 12	12·8	81·3			
W. D. Spencer	May 4	Sept. 27	11·5	71·4	Oct. 31	13·8	78·5
N. Poffenberger	May 8	Sept. 19	11·6	73·5	Oct. 16	14·7	81
L. Johnson	...do	...do	9·5	67·5	Oct. 25	12·6	74
W. F. Sherwel	May 9	Sept. 27	9	67·7	...do	10·4	76·5
Joe Smith	...do				...do	14·8	83·9
John Vaugn	May 10	Sept. 27	12·4	72·1			
M. S. Hildreth	May 11				Oct. 31	12·3	77·2
F. S. Clarke	...do						
J. C. Sullivan	May 12				Oct. 31	12·3	72·2
Frank Leach	May 15	Sept. 19	12·7	76·4	Oct. 25	15	82
George Davis	May 17				Oct. 31	17·2	76·3
C. N. Cox	May 23	Sept. 27	10·4	69·3	Oct. 25	15·1	81·5
Frank Rich	...do	...do	11·6	70	...do	17	84·5
W. E. Renick	May 25	Sept. 19	12·3	77·7	Oct. 16	11·6	68·9
John Peugh	May 26	...do	11	75·3	...do	12·3	74·7
Jack O'Keefe	May 30	Sept. 27	11	78·8			
J. A. Layton	...do	...do	10·9	69·4			
Smith Bros	May 15	...do	13·4	74·9	Oct. 25	16.1	83·7
Arlnes	...do				Oct. 31	12·5	73·8

NOTE.—A. A. Miller and Ed. Bravier shipped a car November 20, which ran 16·2 per cent; 85 purity. Poffenberger and Joe Smith shipped a car November 15, which ran 15·7 per cent; 84 purity. Frank Leach shipped November 20, ran 15 per cent; 84 purity.

These results all show that if the seed were planted earlier, say about March 15, and the crop only watered sufficiently to prevent its drying up, most excellent beets would be ripe for manufacturing purposes by October 15. In every case where the last analysis has shown purity less than 80 we find that the crop was irrigated from two to three or four times, some having had water as late as August 20. None of these beets had any cultivation to speak of. One or two fields only were cultivated twice, a few had one cultivation, but most of them were not touched after thinning, and in only a few cases was the thinning done with any degree of care.

It will be observed in many cases that the analytical data show beets extremely poor for sugar-making purposes. A beet juice in which the

purity falls below 80 needs radical improvement before it can be recommended commercially for the production of sugar. In several instances of the beets examined from the fields in the Grand Valley we find a purity below 80. These soils are undoubtedly rich in alkaline substances and, therefore, could not be expected at first to give a beet with exceptionally high purity. Again, the whole relation of water furnished by irrigation to beet culture needs to be elaborated by careful experimental control, such as can not be secured under the direction of the farmer.

NEED OF EXPERIMENTS IN IRRIGATED REGIONS.

In view of the magnitude of the interests involved a recommendation for the establishment of an experimental station for beet culture in an irrigated region ought to carry great weight with Congress. In fact, it is highly desirable that the experimental results which are so necessary to the proper development of the industry should be obtained under conditions varying as widely as possible. The production of beets in a climate as fickle and capricious as that of Nebraska is well illustrated by the experimental station at Schuyler. The production of beets without irrigation and without rain in the valleys of California should also be the subject of experimental study.

For a proper study of the development of the beet-sugar industry under the varying climate of the United States, at least four experimental stations are necessary. The one in Nebraska is sufficient for the conditions which obtain in Nebraska, the two Dakotas, and to a limited extent in Iowa and Minnesota. A station in an irrigated valley would illustrate the necessary steps in the development of the industry in all of the elevated plateaus of the arid region embraced in Utah, Colorado, Nevada, Montana, New Mexico, and Arizona. A station on the Pacific coast in one of the southern coast valleys of California would serve to study the conditions there obtaining. For the large area represented by northern New York, northern Ohio, northern Indiana, northern Illinois, southern Wisconsin, and the whole of Michigan, a separate station would be necessary.

BEET-SUGAR STATISTICS.

The quantities of beet sugar made in the United States during the past few years are as follows:*

	Pounds.
1887	600,000
1888	4,000,000
1889	6,000,000
1890	8,000,000
1891	12,004,838
1892	27,083,288
1893	†43,953,264

* By courtesy of Commissioner of Internal Revenue.

† Returns to February 1, 1894—one factory still in operation.

The crop in 1893 was made in the following localities:

	Pounds.
Virginia	43,995
Grand Island, Nebr	1,835,900
Norfolk, Nebr	4,107,300
Utah	3,877,100
Alameda, Cal	4,486,572
Watsonville, Cal	15,539,040
Chino, Cal	15,063,357

There are in the United States seven beet-sugar factories, representing an investment of nearly $2,000,000. Tributary to these factories there are at least 24,000 acres of the best agricultural lands. The cost of cultivating all this land if placed in beets would be $960,000. Much of this land is, however, used for rotation, and therefore the the cost of cultivation is less.

The total number of tons of beets manufactured into sugar during the past year, in round numbers, was about 200,353. The average price paid the farmers for this material was $4.50 per ton, amounting, in round numbers to $900,000. The 44,000,000 pounds of sugar made was worth 3 cents a pound, making a total value of $1,320,000. The average bounty received was nearly 2 cents a pound, making approximately $860,000. The total amount of money received for the sugar produced was therefore, approximately, $2,180,000.

EXPERIMENTS AT SCHUYLER, NEBR.

The experiment station at Schuyler, Nebr., established for the purpose of improving the sugar beet and demonstrating the most approved methods of its cultivation, was continued during the growing season of 1893.

THE SELECTION OF "MOTHER BEETS."

During the previous autumn the different standard varieties of beets, as harvested from the experimental plats, were carefully culled for the selection of mothers. In the first selection of mother beets, as has been stated in previous reports, the general appearance of the beet only is considered. A plat of beets having been harvested, a skilled workman is assigned to the task of collecting those which seem to be especially fitted for the purpose of producing seed during the coming year. Beets are selected that are perfect in form, with long and tapering tap roots, smooth exterior, and about 1 pound in weight. These beets are collected, care being taken not to bruise them, and they are at once placed in moist earth until the time comes for siloing for the winter. The tops of these beets which are to be preserved for growing are cut in such a way as not to interfere with the buds at the neck, a part of the stem of the leaf being left on the beet.

SILOING SUGAR BEETS—RESULTS.

The siloing of the beets should not be undertaken until late in the fall when it becomes necessary to protect them from injury by frost. It is highly important that the temperature of the silo do not rise at any time above 45° C. A higher temperature than this induces growth and a consequent loss of saccharine content.

ARRANGEMENT OF THE SILOS.

The beets preserved over the winter at the station were siloed in the following way: They were placed in the silos in a diagonal position, with the tops upward, and carefully packed with moist sand. The silos were so arranged as to be easily ventilated. In the bottom of each silo, at the time the beets were placed therein, was placed a half ton of ice in large pieces, for the purpose of rapidly cooling the temperature of the silo below the growth point. The drainage of the silo was so arranged that the water from the melting ice would not touch the beets. At the closing of the silos on the 5th of November the temperature, as indicated by thermometrical observations, was 43° C.; on the 20th of December the temperature was 42° C., and on the 21st of March, the date at which the silos were opened, the temperature was 39.2° C. These observations show how uniform the temperature of the silos was kept, and at such a point as to prevent to the largest extent any evaporation from the beets or any growth thereof.

The total number of beets placed in the silos was 6,378. When the silos were opened on the 21st of March the beets were found to be in excellent condition; there had been, in point of fact, an increase of weight rather than a loss. This was determined by placing in each silo a given number of carefully weighed beets. These same beets on the opening of the silos were taken out and at once reweighed. Any change in weight would, of course, be revealed by this duplicate weighing.

INCREASED WEIGHT OF BEETS.

An illustration of the increase in weight mentioned is given by the following experiment:

The weight of ten beets siloed on the 4th of November, 1892, was 4,840 grams. The weight of this same lot of beets on the 27th of March, when they were removed from the silo, was 5,400 grams; increase 560 grams, or 11.5 per cent. This increase was due to the fact that at the time of siloing the beets they had become wilted from excessive drouth. The autumn at the station had been particularly dry, and the beets at the time of harvest were in a partly wilted state. These beets, being carefully packed in moist sand and kept at a low temperature, absorbed moisture during the winter with the increase of weight noticed. Ordinarily there would be a decrease of weight in siloed beets, but in the

present conditions the reverse was true. Of the 6,378 beets which were siloed in November, 1892, 6,370 were found in perfect condition when the silos were opened, only eight beets having been spoiled. This is a most remarkable showing and indicates the care with which the siloing was done.

ANALYSES FOR DETERMINING SUGAR CONTENT.

The mother beets, when taken from the silos, are subjected to analysis in the manner described in previous reports. Each beet, after weighing, is turned over to the analyst, who by means of a proper machine removes a cylindrical section diagonally through the beet, thus securing a sufficient quantity for analysis without in any way injuring the beet for germinating purposes. The beet pulp thus secured is subjected to pressure and the juice obtained is analyzed. Inasmuch as the average marc or fibrous portion of the beet pulp amounts to about 5 per cent, the percentage of sugar in the beet is easily calculated by multiplying the percentage found in the juice expressed by 0·95.

The beets were divided by analysis into three classes: The first class included all those beets containing not less than 12 per cent nor more than 15 per cent of sugar; the second class, those beets which contained from 15 to 18 per cent of sugar; and the third or élite class, those beets having over 18 per cent of sugar. The number of beets falling in each classification as a result of the analysis for each variety is found in the following table:

Varieties.	No. 1 grade: Sucrose 18 per cent and upwards.	No. 2 grade: Sucrose 15 to 18 per cent.	No. 3 grade: Sucrose 12 to 15 per cent.
Original Kleinwanzlebener	36	465	448
Dippe's Kleinwanzlebener	6	483	1,176
Vilmorin's Improved	8	600	784
Lemaire	0	0	476
Desprez	0	0	168
Elite Kleinwanzlebener	7	210	224
Total	56	1,758	3,276

These percentages of sugar were determined by taking the analytical data obtained and calculating therefrom the content of sugar which the beets had at the time of harvest. These data for this calculation indicated the analyses at the time of harvest, at the time of storage, and at the time of opening the silos. As a result of the analyses, 5,091 beets were accepted for the production of seed and 1,179 were rejected.

Although the conditions of storage, as indicated above, were the most favorable, yet it must not be forgotten that the vital action of the beet in the silo is not altogether destroyed, but only reduced to a certain minimum. As long as the beet is alive there must be still some action of vitality, and this can only depend upon the consumption of the store of plant food which has been accumulated in the beet itself.

Therefore, even in the favorable circumstances in which the beets were placed, and at a temperature of say 40° C., there was during the duration of the storage sufficient vital action to diminish to a certain extent the total percentage of sugar in the beets. This was determined by analysis of average samples of beets at the time of storage and at the opening of the silos.

Making correction for the increase in weight due to the absorption of moisture during the winter, it was found that the average content of sugar in the beets of all varieties at the time of storage was 12·0; the average at the time of opening the silos had been reduced to 11·6, showing a loss of 0·4 per cent of sugar during the winter.

Some of the varieties lost more sugar than others. For instance, in Vilmorin's Improved there was apparently a gain of 0·1 per cent of sugar during the winter, while in the Desprez variety the content of sugar had not changed nor had it appreciably changed in the Elite Kleinwanzlebener variety.

At the time of the harvest of the beets on the 10th of October the average content of sugar therein was 15·1; at the time of their storage in silos it was 12, and at the time of opening in the spring it was 11·6 per cent. There had been, therefore, a total loss of sugar from the time of harvest of 3·4 per cent. This gave a total loss of sugar from the time of harvest to the time of analysis of 23 per cent; of which 20 per cent, in round numbers, occurred between the 15th of October and the 4th of November (the time the beets were placed in silo), and 3 per cent, in round numbers, from the time they were placed in the silo until their analysis in the latter part of March.

THE PRODUCTION OF SEED.

After the analysis and classification of the mother beets the planting was accomplished by setting them in ground which had been properly prepared. Planting was commenced on the 28th of April and completed on the 2d of May, the different grades being carefully separated in the plats. Special care was taken in this respect in regard to the No. 1 grade (the highest grade) so that they could be sufficiently distant from all other varieties to prevent any contamination by the distribution of the pollen in the fertilization of the seed. Of the 5,091 mother beets which were planted, less than 20 failed to grow, showing a remarkable vitality.

The weather during June was abnormally dry, with a high temperature, but this dry weather did not seem to affect the growth or stand of the plant. There was also another season of dry weather during the latter part of July and the first of August, the temperature being very high caused the seed to mature somewhat early, and thus reduced the quantity of yield. The quality of the seed, however, as indicated by its brightness and weight, was most excellent.

YIELD AND QUALITY OF SEED.

The following data give an idea of the amount of seed obtained in comparison with the yield of seed during the season of 1892. In that year the area planted to mother beets was 98.3 square rods, and the weight of seed obtained 595 pounds, giving a yield per acre of 968 pounds. In 1893 the area planted to mother beets was 113 square rods, and the weight of seed obtained 610 pounds, giving a yield per acre of 863 pounds.

On account of the high quality of the seed it was sold to the Oxnard Beet Sugar Company at a price far in excess of that paid for the best imported seed. The sum received for the seed was at the rate of $172.60 per acre. In regard to the sale of the seed, reference is made exclusively to the seed of the lowest grade. The high-bred seeds of grades No. 1 and No. 2 were reserved for use in experimental work.

COST OF PRODUCING BEET SEED.

The general result of the two seasons' work in the production of seed is of the most satisfactory character. It has been shown that seed of the finest quality can be produced, and the germination of the home-grown seed has showed its high vitality. The fact that a practical beet-sugar manufacturer was willing to pay from 5 to 7 cents more for the lowest or third grade of seed than he would for the best imported seed shows in what esteem this seed was held for practical purposes. It is demonstrated that by proper care beet seed can be produced in this country on one acre of ground planted thereto of a value of at least $150. The actual cost of the production of this seed can not be inferred from the cost of its production in the small way in which it was grown. The extreme care exercised in preventing the varieties from mixing, making it necessary to plant in small plats at great distances, and the extra care and labor which such supervision required, would of course increase the cost greatly beyond that which would be incurred in the production of seed in a purely commercial way. The great point which has been demonstrated by these experiments is the fact that seed can be produced of the value of at least $150 per acre, that this seed is bright and clean and of high germinating power, and, as will be seen further on, will produce a better crop of beets for sugar-making purposes than the best imported varieties.

It remains for future experimental work to develop to the fullest extent the soil, and the climatic and cultural conditions affecting the acclimatization of the high-bred sugar beet of Europe to the conditions obtaining in this country.

EXPERIMENTS IN BEET CULTURE.

The preparation of the plats for planting was commenced in the autumn of 1892. Each plat was thoroughly plowed and subsoiled to the depth of 18 inches in October, and the surface of each plat placed

in proper tilth. The spring of 1893 found the ground in excellent condition, the surface having been thoroughly pulverized by the frost. The soil, however, in the spring was not thoroughly saturated with water, on account of the extremely dry autumn and the failure of the winter's snows to furnish sufficient moisture on melting to thoroughly saturate the undersoil. This did not apply particularly to the suface of the soil, which was moist enough, but to the water reserve below the subsoil and upon which the subsoil and the soil would be compelled to draw in case of another dry season. The preparation of the plats for planting was finished in April and the seed, both of foreign and domestic production, thoroughly tested in regard to its vitality. The planting commenced on the 10th of April and continued at intervals for six weeks.

Careful observations in regard to the germination of the seed showed that as a rule the home-grown seed appeared above ground from one to two days in advance of the corresponding imported varieties. In all cases, in order to secure proper tests, the home-grown and imported seeds were planted side by side, not only at the first but at all subsequent plantings.

On April 22 the temperature fell to 13° C., and this winter temperature put a decided check to the operations of the station and of necessity injured greatly the plantings which had been made previous thereto. By reason of this abnormally cold weather the close of April found vegetation in rather a discouraging condition. For the sake of economy only 5 acres were planted in beets in the spring of 1893, instead of 8 acres, which was the originally intended area for the proper rotation of the station crops. In spite of these discouraging circumstances, however, all the plats presented an even appearance by the beginning of June. On the 7th of June a great dust storm swept over the district. The wind came up from the southwest at 4:30 p. m., and at 5 o'clock nearly every young beet plant had been cut off close to the ground. Only one acre of the total area planted escaped total destruction, and this was so badly damaged in places that the aftergrowth was very slow, and the final crop the poorest on the station.

The most serious result of this storm, together with another one which came on the 9th of June, was the total destruction of the plants which had been started from the first or highest grade of home-grown seed. The comparative tests were therefore made with the second grade of seed instead of the highest.

All the plats injured were replanted by the 15th of June. The rate of germination of the seed planted at this period was quite in contrast with that of the earlier plantings. The plants from the home-grown seed were visible above ground in seventy-two hours, while those of the imported seed were first visible after one hundred and twenty-four hours, being a conclusive proof of the superior vitality of the home-grown seed.

The cultivation of the plats was more satisfactory than that of any previous years, because the laborers employed were the same who had been employed in former seasons and their acquaintance with the methods of beet culture was, therefore, more thorough.

The meteorological conditions for the growing season are summarized in the following table:

Observations.	May.	June.	July.	August.	September.
Temperature.	°	°	°	°	°
Means for 1893	58·4	72·2	75·0	70·7	65·1
Means for 1892	55·3	66·6	75·0	72·8	66·5
Means for 1891	59·0	68·4	69·9	70·2	65·1
	Inches.	*Inc. es.*	*Inches.*	*Inches.*	*Inches.*
Rainfall 1893	4·27	1·64	4·69	2·61	2·03
Rainfall 1892	6·62	·50	2·50	3·36	0·28
Rainfall 1891	1·38	11·59	6·71	2·22	0·84

Fortunately the insect ravages which produced such disastrous effects on the crop of 1892 were entirely absent during the season of 1893. The cultivation of the crop and its laying-by followed in due order, and on the 4th of September the first of the analytical work in the examination of the new crop was commenced.

ANALYTICAL DATA.

As a result of the first series of examinations in the beginning of September it was found that the home-grown seed had produced a greater weight of beets per acre while they had the full equivalent of sugar content.

Compared with the crop of 1892 the data are as follows:

The mean weight of all varieties of beets in 1892, in the beginning of September, was 279 grams, and the sugar content 10·6 per cent. At the same season in 1893 the mean weight of the beets was 389 grams and the mean sugar content 11·6 per cent. It is thus seen that in both the weight of the beet and the content of sugar the crop of 1893 at this season was superior to that of 1892.

On September 28, as determined by experiment, the mean weight of all home-grown varieties per acre was 13·5 tons, containing 15·8 per cent of sugar, or 4,266 pounds per acre. The mean weight of the imported varieties per acre was 13·3 tons, containing 15 per cent of sugar, or 3,990 pounds per acre.

The data given above were obtained upon beets planted during April and May. It may be of interest to compare these data with those obtained from beets planted later. The beets on which the following observations were made were planted on the 12th of June, and on the ground where the previous early planting had been destroyed by the windstorms. This planting, as has already been mentioned, germinated in an unusually short time, and the subsequent growth was rapid and uninterrupted. As perfect cultivation as possible was given to

the crop, and the surface of the soil was kept in good tilth during the entire growing season. On the first of September the plats presented a splendid appearance, although the beets were far from mature. After the first of September the extremely hot and dry weather began to affect the late-planted beets, and it was observed that they were ceasing to increase in weight. Small plats were subjected to irrigation in order to determine whether any difference would be observed between the irrigated and non-irrigated beets. At the time of the harvest of the beets, a month later, it was observed that the surface irrigation had not penetrated to a depth of more than 6 inches, and below that depth the soil was dry and hard.

The late-planted plats were examined analytically only once, and as each variety did not contain more than a few hundred beets, most of which it was desirable to keep for seed, it was not thought wise to take a large number for examination, nor to repeat the analytical work. A time for analysis was therefore selected when it was supposed the beets had approximately reached their maximum of value in weight and sugar content. The results obtained for the different varieties were extremely flattering. The highest sugar content was found with the Elite Kleinwanzlebener, namely, 16·4 per cent, with a purity of 81·5, and all the other varieties approximated closely these figures, except in one instance. The varieties were all grown from domestic seed produced upon the station. The weight of the beets, however, was rather low, being only about two-thirds of the normal weight of a perfect sugar beet, showing that the excessively dry weather of September had prevented them from attaining full growth. The weight per acre and the sugar per acre of each of the late-planted plats are given in the following table:

Table showing yield per acre of sugar derived from different varieties of beets.

Varieties.	Seed.	Date.	Weight per square rod.	Yield per acre.	Sucrose.	Sugar per acre.
			Pounds.	*Tons.*	*Per cent.*	*Pounds.*
Elite Kleinwanzlebener	H	Sept. 28	172	13·7	16·4	4,513
Vilmorin's Improved	H	...do	150	12·0	16·3	3,912
Dippe's Kleinwanzlebener	H	...do	161	12·8	15·4	3,967
Lemaire	H	...do	178	14·2	15·3	4,348
Knauer	H	...do	190	15·2	16·3	4,955
Desprez	H	...do	178	14·2	15·2	4,316
Original Kleinwanzlebener	I	...do	143	11·4	16·0	3,661
Lemaire	I	...do	190	15·2	14·0	4,620
Means of varieties from home-grown seed				13·5	15·8	4,266
Means of varieties from imported seed				13·3	15·0	3,990

Two of these experiments were also duplicated with imported seed, namely, those marked "I" in the table above. The low yield per acre was without doubt due to the severe drought.

There was an appreciable increase in the yield per acre of the irrigated plats without any appreciable decrease in the content of sugar.

The mean yield per acre of the irrigated beets was 16·2 tons; the mean percentage of sugar in the beets, 15·3 per cent, and the mean yield of sugar per acre, 4,954 pounds. The irrigation, therefore, had increased the yield of sugar per acre, in round numbers, 700 pounds.

THE GROWTH OF BEETS AT DIFFERENT ALTITUDES.

A series of experiments was also made in connection with the work at the station in growing beets on the bottom lands of the Platte River. Heretofore it has been considered impracticable to grow beets on this soil, subject as it is to overflow in the spring and being of an extremely sandy nature. The level of the surface of this soil is very little above that of the river, so the water line through the greater part of the year is very near the surface of the soil. These lands, of course, would be expected to produce a good showing only during an excessively dry year, as during the season of 1893. The spring of 1893 being immoderately dry, allowed the lowlands to be worked and beets to be planted early in May. The germination was rapid, and the beets grew without hindrance up to the time of maturity. On September 23 the beets were analyzed, and at the same time a similar number of beets grown by the same farmer, in the same manner and from the same seed, but upon dry soil lying higher. The comparison of the two harvests is shown by the following data: Grown on the lowland—Mean weight of beets, 523 grams; mean percentage of sugar, 13·5; mean purity, 82·8. Grown on the dry upland—Mean weight of beets, 381 grams; mean percentage of sugar, 11; mean purity, 68·3. In this instance it is seen that the difference is wholly in favor of the beets grown upon the lowlands. The uncertainty of the possibility of the cultivation of these lands, however, in the spring makes this experiment only a matter of interest in showing the necessity for a moderate supply of moisture during the growing season.

The table-lands of Nebraska are not capable of supplying a definite amount of moisture from the subsoil to a growing crop, especially to one which requires so much water for its nourishment as the sugar beet. In this respect they are quite different from the lands of the Chino Valley, California, in which crops of beets are often grown, receiving their water solely from subterranean sources. The practical lesson learned from this experiment does not indicate the continuous availability of the bottom lands of the Platte for beet-growing, but the necessity of a deeper and more thorough working of the subsoils of the uplands in order to increase the store and availability of the capillary water of the soil. Nevertheless, in this connection it may be well to speak of the fact that the Standard Cattle-Feeding Company, of Ames, Nebr., planted during the last year about 500 acres of beets on what is practically bottom lands. The yield obtained per acre was quite satisfactory and the content of sugar was also high. I regret that the officers of the company are not willing to have the data published in detail, but I am permitted to say that the results of the experiment were satisfactory both from

an agricultural point of view and financially, the beets having been delivered to a factory and a fair profit realized from them.

UNFAVORABLE CLIMATIC CONDITIONS OF NEBRASKA.

The climatic conditions that have attended the three years' experiments which have been conducted at Schuyler lead to the conclusion that the climate of Nebraska, in respect to its variations in temperature and rainfall, is not well suited to production of uniform crops of sugar beets. The variations in temperature are phenomenal; even during the summer very cold and very hot days may succeed each other in quick succession. The variations in rainfall are no less marked. At one time of the year excessive precipitation is likely to occur, followed naturally by excessive drought. All of these excesses of climate are without doubt injurious to the growth of a plant which has been developed under such even conditions as have characterized the growth of the sugar beet in Europe during the past seventy-five years. The plain deduction from these data is that the sugar beet, especially in such a climate as that of Nebraska, will undergo some changes, due to the effect of its environment, to accommodate itself to such changed conditions. Even after only two years of growth in the conditions there obtaining the domestic beet shows undoubted marks of superiority.

One encouraging feature of the problem is found in the fact that in spite of these great variations in temperature and precipitation, and chiefly with imported seeds for the production of the plants, we have been able to grow in three seasons, differing very widely in climatic conditions, crops of beets fairly satisfactory in both yield per acre and sugar content. This result shows that with the highest skill in agriculture and proper acclimatization a country, even with such a variable climate as Nebraska, may be made in one sense practically independent of these excesses of seasonal changes.

SPECIAL EXPERIMENTS IN SUGAR ELABORATION.

In addition to the general experiments which have been outlined above a number of special experiments in the production of sugar beets was also carried on at the Schuyler Station, as has been the custom in previous years. These experiments will be found fully described in the report of Mr. Maxwell, which follows. Attention will be called to only one of them here.

The interesting observations noted by Mr. Maxwell, the assistant in charge, in regard to the function of moisture in the storage of beets will be found in detail in his report. The results of these experiments are convincing to Mr. Maxwell of the formation of an additional quantity of sugar in the beets after storage. The special report justly calls attention to the fact that this conviction is in opposition to the accepted theories in regard to this matter. It is not desired, therefore, to cite these experiments for the purpose of committing the Department to any definite statement in regard to this question. The whole science of

vegetable physiology and chemistry teaches that sugar is elaborated in the leaves of the beet plant by the condensation of formyl aldehyd, which is produced by the action of the chlorophyl cell upon carbon dioxid and water. The beet itself has always been regarded simply as a store-house in which the elaborated sugar is conserved for the future use of the plant.

It is not at all impossible that sugar elaboration may go on in the cellular substance of the beet itself, although such an assumption is contrary to the generally accepted theories of vegetable chemistry. The experiments are so few in number that judgment must be reserved in regard to the matter until they may be repeated under varying conditions. In such cases the final determination of the question can not be made upon an analysis of the expressed juice alone, but must be determined by the estimation of the quantity of sugar in the beet itself without expression. In other words, the relation of the marc or pulp of the beet to the question under consideration must also be taken into account as well as the content of sugar in the juice alone.

It seems improbable in the present light of vegetable physiological chemistry to suppose there is any elaboration of sugar in such circumstances. The fact of the increase in the purity of the juice would lead to a supposition, however, that some of the materials already present in the juice are converted in some way into sucrose. That any formation of sucrose in the beet itself during storage in moisture can be secured by the condensation of carbon dioxid and water is beyond the just expectation of the accomplishments of physiological vegetable action.

GENERAL CONSIDERATIONS.

So many letters are addressed to the Department of Agriculture making inquiry in regard to the prospects of the beet-sugar industry in the United States that it seems proper to say a few words here on this subject.

The cultivation of the sugar beet is a style of agriculture so strange to American farmers as to require specific instruction and experience in order to successfully accomplish it. For this reason it is not difficult to foresee that any attempt by American farmers to plunge at once into extensive beet culture until they have learned its principles and practice must end disastrously. The great obstacle to the spread of the beet-sugar industry in the United States is without doubt an agricultural one. The experiments which have been conducted by the Department at Schuyler and the results of an immense amount of work done at the various agricultural experiment stations in the different States, together with the practical work accomplished by the seven active beet-sugar factories in the United States, have demonstrated beyond any possible doubt the fact that beets of a reasonably high sugar content can be produced over wide areas and in quantities approximating those produced in the beet fields of Europe.

In so far as the manufacturing is concerned the conditions are practically identical, although it must be admitted that in some parts of the country the conditions are more favorable and in others less favorable than in Europe. As an instance of more favorable conditions the experience of California may be cited. On account of the mild winters in that locality it is not found necessary in any case to silo the beets, and unless exposed to the danger of second growth they can be allowed to remain in the ground until the time for manufacture arrives. There is thus a considerable diminution of the expense of manufacture—an expense which comes from the labor of harvesting and siloing the beets and protecting them from frost.

On the other hand, the conditions in Nebraska are distinctly less favorable for manufacture than in Europe. In the climate of the former the access of winter is often sudden and early. It is not unusual for the thermometer to reach the zero point in November. It therefore becomes absolutely necessary that the harvest of the beets should be fully accomplished perhaps not later than the 20th or 25th of October. The whole excess of beets not manufactured at that time must therefore be preserved, and this preservation is an expensive operation in a climate where so severe a degree of frost must be expected. Then, again, the periods of cold may be separated by periods of great warmth. In this case another danger arises; the high temperature which the silos may attain at that time induces growth, or, if the buds making the growth possible are all removed, at least deterioration. Taking all parts of the country together it may be said that the conditions of manufacture, including the abundance of fuel and its cheapness and the other factors active in determining the cost of production, are as favorable as in Europe. There is one exception to this, of course, and that is in the matter of labor, the cost of which in this country is double, sometimes triple, that paid in Europe for similar service.

During the past year nearly 45,000,000 pounds of beet sugar have been produced in the United States.

REPORT OF ASSISTANT IN CHARGE.

The details of the experimental work at the Schuyler Station are contained in the report of Dr. Walter Maxwell, assistant in charge, which is as follows:

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF CHEMISTRY,
Washington, D. C., December 20, 1893.

SIR: I beg to submit to you the third annual report of the work of the U. S. Department of Agriculture sugar beet experiment station at Schuyler, Nebr., for the year 1893.

Very respectfully,

WALTER MAXWELL,
Assistant in Charge.

Prof. H. W. WILEY,
Director of Station.

The sugar beet experiment station commenced the work of the season of 1893 in the first week of March, the farm foreman, George Selzer, opening up the laboratory on the 2d day of the month. Preparations were made in the laboratory for conducting the analysis of the "mother beets." The abnormal and continuous low temperature, however, prevented the silos being opened until March 21, on which date the chemical work began.

METHOD OF STORING BEETS.

The mode of storing the mother beets in November, 1892, was varied from the method described in full detail in my report of last year only by the circumstance that at the time of closing the silos fully one-half ton of ice was placed in each silo for the purpose of lowering the temperature. The ice was placed in such a way that it was not in immediate contact with the beets, and in order that the water should run directly into the ventilating channel underlying the floor of the silo.

Upon inspection, the beets were found in a condition in every particular satisfactory. No visible growth had transpired, and the flesh of the roots was apparently more solid than it was at the time of storing.

EFFECT OF STORAGE ON WEIGHT OF BEETS.

In order that the character of the preservation, with respect to the loss or increase of weight by heating and evaporation, could be gauged, and likewise for the purpose of fixing the standard, which is based upon the water content, for determining the proportion of loss in sucrose, a given number of beets was washed, dried, and weighed and placed in an average position in the silos at the time of storing, and on reopening, those beets were washed and reweighed immediately. The effect of storage upon the weight of the roots is shown in the following table:

	Grams.
Weight of 10 selected beets March 27, 1893	5,400
Weight of 10 selected beets November 4, 1892	4,840
Increase of weight during the term of storage	560
Per cent of increase	11.5

The occasion of the great increase of weight in the beets which had taken place, as shown by the table, is found in the two following main causes: At the time of storing in the preceding autumn the beets were in an abnormally wilted condition, owing to the extreme heat and drought which prevailed previous to their removal from the soil. The roots thus, at the period of entering the silos, contained less than the normal amount of water, and being interlaid by layers of cold, moist sand, as described in the last year's report, the moisture equivalent was regained. Further, the placing of ice in the silos at the time of closing lowered the temperature, and reduced the possible measure of evaporation, which is shown by the thermometrical readings in the following table:

	Degrees C.
Temperature of the silos November 5	43
Temperature of the silos December 20	42
Temperature beet juices March 21	39·2

Not only could no evaporation take place with the silos maintained at such a low temperature, and the beets packed in moist sand, but the reason is likewise furnished why no growth had begun. At the degree of temperature which the juices gave on the opening day of the analytical work (39·2°) sprouting could not occur. During the winter of 1891, no change had taken place in the weight of the beets, but a notable growth had occurred, which was due to a higher temperature prevailing during the term of storage in the silos, and also to the circumstance that the opening of the silos did not take place until three weeks later in the following spring. The effect of storage upon the sugar content will be seen from the tables of analytical data.

CHEMICAL ANALYSES.

As already stated, the chemical work began on March 21, and was concluded April 8; 6,370 beets being analyzed, against 4,740 analyzed in the spring of 1892. The number of beets contained in the silos was 6,378, showing that only 8 beets in the total number stored had suffered decay.

The classification of the beets was based upon the analyses, the sugar content resolving the individuals of each variety into the grades of quality shown in the following table:

Variety.	No. I grade (sucrose 18 per cent upwards).	No. II grade (sucrose 15 to 18 per cent).	No. III grade (sucrose 12 to 15 per cent).
	Beets.	*Beets.*	*Beets.*
Original Kleinwanzlebener	36	465	448
Dippe's Kleinwanzlebener	6	483	1,176
Vilmorins' Improved	8	600	784
Lemaire	.....	.....	476
Desprez	.....	.....	168
Elite Kleinwanzlebener	7	210	224
	57	1,758	3,276

The following statement gives the proportion of the beets analyzed which was eligible for propagation uses:

Number of beets of all grades accepted for seed production	5,091
Number of beets of all grades rejected for seed production	1,179
Total	6,370

EFFECT OF STORAGE ON SUGAR CONTENT.

The effect of storage upon the sugar content is observed by comparing the relative proportions of sucrose found in the average samples of each variety at the time of siloing and when the beets were taken out for analysis. The increase of weight in the beets, which it has been shown had taken place during the term of storage, has to be included in the consideration, and the 11·5 per cent, which was the precise ratio of the increment, must be added to the sucrose readings in order that the comparison between the autumn and spring readings may be exact and the actual loss of sugar determined.

The following statement furnishes the sucrose readings of each variety, as recorded in November, 1892, and the spring readings of the varieties, plus the equivalent of the weight increment:

Varieties.	Sucrose Nov. 4.	Sucrose Mar. 21.
	Per cent.	*Per cent.*
Original Kleinwanzlebener	13·1	12·8
Dippe's Kleinwanzlebener	13·5	12·0
Vilmorin's Improved	11·4	11·5
Lemaire	10·4	10·0
Desprez	10·8	10·8
Elite Kleinwanzlebener	12·6	12·5
Means	12·9	11·6

From the table it is seen that nearly one-half of 1 per cent is the difference between the sugar content of the siloed beets in the autumn and in the following spring.

Those beets, however, at the time of their removal from the soil on and about October 10, 1892, contained 15·1 per cent of sucrose; so that during the total inter-

val of time between their removal from the soil in the previous autumn and the date of analysis in the spring, the polariscope readings had fallen 3·5 per cent, which gives a mean loss in the total sugar of all the varieties of 23·1 per cent; 19·9 per cent of which occurred between October 15 and November 4, and 3·2 per cent during the time that the beets were closed up in the silos from November 5 to March 21.

It is seen from the table that the varieties did not pass through the term of winter storage with equal advantage. This feature of the results requires further investigation, both with respect to its accuracy and to the cause, if it is found to be accurate. The matter of the loss of sugar which transpired in the autumn, and before the beets were placed in silo, is fully discussed in my report for 1892. The loss, however, of only 3·2 per cent of the total sugar during the term of storage, the almost complete immunity from decay, and the solid condition of the beets when taken out of the silos, justify the conclusion that the mode of preservation in use is in all respects satisfactory.

PLANTING MOTHER BEETS.

The planting of the mother beets was done between the dates April 28 and May 2. The method of the previous year was departed from in two respects: The No. 3 grade beets of all varieties were planted on the same plat; the No. 2 grade were placed at extreme points of distance on the station, whilst the No. 1 grade, or "Extra Quality," were planted in selected spots 1 mile distant from each other and from the station. The station was enabled to observe this great care in placing the varieties of No. 1 grade a great distance from each other through the courtesy of Messrs. Wells & Nieman, upon whose ranch two varieties were planted, and of Mr. Fuller, of the Maxwellian Ranch, whose interest in the work caused him to offer any part of his land, and likewise an excellent plat in his private garden, for the purpose.

The planting was done in every way satisfactorily, and the beets very soon exhibited their great vitality. Of the 5,091 beets planted less than 20 failed to grow; and notwithstanding the dry weather, with high temperature, which prevailed during the month of June, which is normally moist and growing, the growth was not affected, the "stand" of each plat reaching an excellent development.

The high temperature of the latter part of July and of the first days of August, during which time practically no rain fell, caused the seed to mature prematurely, and reduced the bulk of the yield, certain "stands" actually drying out, whilst the seed generally did not attain its possible size. The quality, however, as indicated by the brightness of the seed and the weight, was excellent. Had rain fallen in moderate proportion during the early part of the maturing season the yield per acre would probably have been greater by 30 per cent. The seed was all collected by August 31.

YIELD OF SEED—VALUE.

The following data give the actual seed obtained in comparison with the yield of 1892:

Season.	Varieties.	Area.	Weight of seed.	Yield per acre.
		Rods.	*Pounds.*	*Pounds.*
1893	Seed of all varieties	113·0	610	863
1892	do	98·3	595	968

The yield per acre is a little lower this season than in 1892.

Arrangements were made with the president of the Oxnard Beet Sugar Company for the purchase of the seed at the sum of 20 cents per pound, which gave the seed crop a value of $172.60 per acre.

The seed of all varieties of the No. I and No. II grades has been retained, however, in order that it may be available should the work of the station be resumed in the spring of 1894.

CULTURAL SEASON OF THE BEET CROP.

The work of preparing the ground for the beet crop of this year was begun in the autumn of 1892. All surface cleaning was done in August; deep plowing and subsoiling, as described in my previous reports, were completed in October, and the so-called heavy and preparatory cultivation accomplished before the frosts of the late autumn came on.

In the spring the ground was in excellent condition; the frost having thoroughly pulverized the soil of the plats plowed in the preceding fall. One feature, however, was not satisfactory, which was the water reserve of the soil. The preceding summer had been dry and hot, and the rainfall common to the month of October was extremely small, consequently the water reserve of the soil at the beginning of winter was at the minimum, which was not remedied during the winter months. It was thus apparent that if another hot and dry summer should follow, with the water reserve of the soil so low in the spring, the results of the drouth would be increasedly disastrous. It will be seen later that these results were realized.

The preparation of the plats for early planting was begun on April 9, and on the following day one acre of beets was planted, the seed bed being a mass of fine, moist earth in good tilth, and the soil temperature reading 55° C.

All the seed was tested and the vitality proved by germination which was conducted in boxes in the laboratory. The following table shows the germinating power of each lot of seed planted, and the vitality of the "home-grown" seed in comparison with "imported" of the same varieties.

Planted May 23—100 seeds.	May—			June—						
Number of plantlets visible on	29	30	31	1	2	3	4	5	6	7
Vilmorin Improved (home-grown)	8	50	89	94	95	97	97	97	97	97
Dippe's Kleinwanzlebener (home-grown)	1	22	62	78	82	85	87	88	90	91
(imported)	....	7	27	53	66	75	78	80	85	87
Elite Kleinwanzlebener (home-grown)	1	30	61	71	76	80	82	83	84	89
(imported)	....	4	23	44	56	60	67	69	76	78
Knauer (home-grown)	13	59	81	85	87	87	87	87	87	88
(imported)	2	21	51	71	78	83	83	85	86	87
Lemaire (home-grown)	13	55	83	85	87	87	87	87	87	87
(imported)	9	48	83	90	96	96	96	96	97	97
Desprez (home-grown)	8	47	79	85	90	92	93	94	95	95
Mette's Specialität (imported)	....	12	35	58	77	79	82	84	87	88
Mette's Rosa Elite (imported)	....	21	50	71	75	77	77	77	77	78
Demesmay (imported)	2	4	19	44	57	63	66	69	69	69

The notable feature of the germination tests is the uniformly high germinating power of the home-grown varieties and the rapidity with which the plantlets appeared above the ground. It is seen that the native seed is from one to two days in advance of the imported of corresponding varieties in breaking the surface of the soil. An exception occurs among the imported in the instance of the Lemaire, but even with that variety the home-grown seed came up more rapidly, although not so high a percentage grew. The observations recorded in the above table were confirmed in the field, the home-grown seed coming up one to two days earlier than the imported, and being ready in advance for "thinning out."

On April 15 two more acres were planted. The home-grown and imported seeds of each variety were planted side by side, all conditions being equal. By this mode of planting the results would be comparative, and the value of the home-grown seed exactly tested.

On April 22 the minimum thermometer registered 13°, a phenomenally low temperature for that season. With the low temperature, strong winds prevailed, the latter

continuing after the temperature rose. At the close of April the aspect of vegetation generally was very discouraging.

Only 5 acres were planted in beets instead of 8 acres, as in former years, the extent allowed to each variety being lessened. Under instructions, the cultivation and expenditures were reduced to the lowest scale compatible with the purpose of efficiently conducting the experiments.

Damage by dust storms.

All the plats which had been planted presented a perfect appearance at the beginning of June. On June 7 a terrible dust storm swept over the district. The wind came up from the southeast at 4.30 p. m., and at 5 o'clock nearly every young beet plant had been cut off close to the ground. The prospect was bad. The damage wrought by the storm was of wide extent, hundreds of acres of excellent stands of beets being utterly destroyed in the beet districts of Norfolk and Grand Island.

When the storm had passed by only 1 acre of beets remained which presented any kind of appearance. This plat was left standing; the plants, however, were so fatally damaged in places that the after-growth was very slow, and the final crop the poorest on the station. It is advisable where the plants are damaged by such storms to plow up the ground and replant, the results will more than compensate the expense of extra cultivation.

On June 9, a second storm occurred which cut off certain other small experiments conducted with the "extra quality" home-grown seed. The whole of the plants from the No. 1 grade seed was lost, and the comparative tests were confined to plantings of No. 2 grade, home-grown, with seed of the same varieties imported direct from France and Germany.

On June 15, only 3 acres of beets were in progress of growth. The last acre was replanted upon the plat where the storm had destroyed the planting of an earlier date. This acre was planted with 6 varieties of home-grown and 2 varieties of imported seed. The rate of germination was extraordinary. The plantlets of the home-grown seed were visible in the row seventy-two hours after planting, which is probably the shortest time on record required by the beet seed to develop into appearance above the ground. The imported seed planted at the same time was visible in the rows after one hundred and twenty-four hours, or two days later. This is the most conclusive example of the greater vitality and germinating power of the native seed.

In speaking of the disaster caused by the dust storm, it may be noted that the lands which were lying with very compact and fine surfaces, caused by sudden rains or rolling, were most subject to the action of the wind. Lands which had been recently worked, and were not so flat, did not "blow," or extremely little, and the small clods protected the beet plants. As a provision against such storms, it thus appears advisable to pass the cultivator along the rows as soon as the plants appear, even if no weeds have come up, if only to protect the plant against that danger.

On very light sand soils nothing will avail against the winds, but on such lands beets should not be planted, and for other well-known reasons in addition to the danger of blowing.

Native and imported plants compared.

The thinning out of the plants was done satisfactorily, the laborers being those who were trained to the work in the two previous seasons. On the early planted plat the beets were placed 8 inches apart in the row; in the next plat, or May planting, 9 inches were left between the plats, while on the plat planted on June 12 the plants were set 1 foot apart, the distance between the rows, on all plats, being uniformly 18 inches.

Following the thinning out, hand-hoeing and cultivation with the horsehoe were continued until the plants were too large to be further worked without damage. The early planted plats were laid by about July 12, but work was continued in the

latest plat until July 28, when all work among the plants ceased. At this time the prospect was excellent. All the varieties made a good appearance, yet the greater vitality and rapidity of growth shown by the home-grown seed in the stage of germination was still maintained. The plants from the native seed produced a more abundant foliage system and the roots were apparently correspondingly better developed than were those from the imported seed of the same varieties. The question of the most vital interest at that period was, Will the greater promise of the product from the home-grown seed be maintained to the end?

Influence of climatic conditions.

From the time of laying by the crop to the time of maturity the matter is wholly in the hands of the climatic conditions. At the beginning of the season I observed that should even a moderately dry season occur, with the low water reserve of the ground which in the spring existed, the result would be disastrous. That condition did follow. The rainfall of June was less than one-half of the normal for the month and the weather conditions of June are almost decisive. The precipitation in July was quite insufficient to make up for the deficiency of the previous month and to resist the high temperatures of that season. The first half of August was wholly without rain and the precipitation for the month was below the normal, while with September the drought became chronic, no rain occurring in the month until the night of the 29th. And, with the small rainfall, the midsummer was characterized by very high temperatures, June and July each having a mean record of several degrees above the normal for those months.

Weather conditions.

Observations.	May.	June.	July.	August.	September.
Temperature.	°	°	°	°	°
Means for 1893	58·4	72·2	75·0	70·7	65·1
Means for 1892	55·3	66·6	75·0	72·8	66·5
Means for 1891	59·0	68·4	69·9	70·2	65·1
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*
Rainfall, 1893	4·27	1·64	4·69	2·61	2·03
Rainfall, 1892	6·62	0·50	2·50	3·36	0·28
Rainfall, 1891	1·38	11·59	6·71	2·22	0·84

From these data it is seen that the temperature of this season, during the most vital period, was much above the temperatures recorded in the two previous years. And the rainfall for the five months tabulated was wholly inadequate as a supplement to the low-water reserve of the ground existing at the beginning of the year. The rainfall of 1891, badly distributed though it was, was the amount of precipitation most favorable to the beet crop in Nebraska.

Happily, I have no statement to make concerning insect ravages during the closing season. A few individuals of the worm which wrought the great damage reported last year were observed in the middle of July, but the number was quite insignificant; and no second generation was observed to appear.

ANALYTICAL WORK OF THE SEASON.

On September 4 the first samples of beets were analyzed. Excepting the late-planted plats, the crop was sampled and tested, and the weight and sugar content ascertained in correspondence with the mode of control practiced in 1892.

Before giving a table of the results observed at the opening of the analytical season it must be remarked that certain early plantings of home-grown varieties of seed were wholly destroyed by the dust storm of June 8, and a comparison with the product of the imported seed of those varieties can not be made. In the later planting the comparison will be possible.

The following table represents the condition of the crop from the given varieties of home-grown and imported seed in the first week of September:

Varieties.	Seed.	Date.	Number of beets.	Mean weight of beets.	Brix.	Sucrose.	Purity.
				Grams.	*Per cent.*	*Per cent.*	*Per cent.*
Original Kleinwanzlebener	I*	Sept. 4	50	300	15·0	11·0	73.3
Vilmorin Improved	I	...do	50	275	16·1	12·5	77·6
Elite Kleinwanzlebener	H†	Sept. 5	50	396	15·4	12.0	77·9
	I	...do	50	387	15·0	10·9	72·6
Knauer	H	...do	50	521	14·8	10·6	71·6
	I	...do	50	443	15·3	10·9	71·2
Lemaire	H	Sept. 7	50	358	16·6	11·9	71·5
	I	...do	50	341	15·8	10·8	68·3
Desprez	H	...do	50	420	16·1	11·8	73·3
Mette's Specialität	I	Sept. 8	50	335	17·0	12·4	73·0
Vilmorin Improved (second planting)	I	...do	50	359	18·4	13·8	75·0
Mette's Rosa Elite	I	...do	50	391	14·8	10·2	69·0
Mean of imported seed				354		11·5	
Mean of home-grown seed				424		11·6	

*Imported. †Home-grown.

The above table shows the condition of the crop at the beginning of September. It is seen that the home-grown seed represents a greater weight of beets per acre and a full equivalent in the sugar content. It will be of interest to compare the given condition of the crop of this year with that of 1892 at the same date:

	Weight of beets.	Sucrose.
	Grams.	*Per cent.*
Mean of all varieties, 1893	389	11.6
Mean of all varieties, 1892	279	10.6

It is thus shown that the crop of this season was in a highly satisfactory condition, in comparison with the crop of 1892, in the first week of September.

As has already been stated, extreme drought prevailed during the greater part of August and through the month of September, the effects of the absence of rain being intensified by the high temperatures. It was most apparent that the beets had not only ceased to increase in weight, but that they had less weight than two weeks previously. Also, the behavior of certain of the varieties, with respect to their sugar content, was perplexing, and the indications for the results of the season far from promising. These peculiarities will be better seen from the table which represents the second analytical review of the condition of the crop:

Varieties.	Seed.	Date.	Number of beets.	Mean weight of beets.	Brix.	Sucrose.	Purity.
				Grams.	*Per cent.*	*Per cent.*	*Per cent.*
Original Kleinwanzlebener	I	Sept. 11	50	280	16·3	12·3	75·4
Vilmorin Improved	I	...do	50	299	17·0	13·2	77·6
Elite Kleinwanzlebener	H	Sept. 12	50	505	16·2	12·6	77·7
	I	...do	50	393	15·7	11·2	71·4
Knauer	H	Sept. 13	50	506	15·2	11·1	72·5
	I	...do	50	446	16·5	12·2	73·8
Lemaire	H	Sept. 14	50	372	17·0	11·8	69·0
	I	...do	50	395	17·5	11·9	68·0
Desprez	H	...do	50	391	17·4	12·6	72·0
Mette's Specialität	I	Sept. 15	50	335	17·0	12·1	71·2
Vilmorin Improved (second planting)	I	...do	50	362	18·8	14·0	74·4
Mette's Rosa Elite	I	...do	50	350	15·6	10·3	66·0

From this table it is seen that certain of the varieties gave a higher polariscope reading than in the previous week. The gain, however, was not wholly actual. A decrease in weight had occurred, caused by evaporation, under the action of the hot dry weather, and the ratio of solids in the beet had risen in proportion to the withdrawal of water.

It is observed, moreover, that, notwithstanding the decrease of weight of certain of the varieties, the per cent of sugar found in the juice was less than in the previous week. This is a phenomenon which had not been encountered in previous experimentation. Its discussion will be deferred to a later stage of the report, and in connection with specific experiments treating of the matter.

The following table records the data obtained in the third inspection of the varieties:

Varieties.	Seed.	Date.	Number of beets.	Mean weight of beets.	Brix.	Sucrose.	Purity.
				Grams.	*Per cent.*	*Per cent.*	*Per cent.*
Original Kleinwanzlebener	I	Sept. 21	50	299	18·1	13·6	75·2
Vilmorin Improved	I	...do	50	317	17·9	13·7	76·0
Elite Kleinwanzlebener	H	Sept. 22	50	522	16·4	12·9	78·6
	I	...do	50	407	15·7	11·1	71·2
Knauer	H	...do	50	517	15·5	11·6	74·8
	I	...do	50	459	16·6	12·6	75·8
Lemaire	H	Sept. 25	50	362	17·6	11·6	65·8
	I	...do	50	333	18·1	12·6	69·6
Desprez	H	...do	50	397	17·8	12·8	71·9
Mette's Specialität	I	...do	50	311	17·9	12·5	69·8
Vilmorin Improved (second planting	I	...do	50	353	18·5	13·2	71·3
Mette's Rosa Elite	I	...do	50	329	16·5	10·2	61·8

This table shows that, comparatively, no increase in the sugar content of the beets had taken place during the interval of the week. A specific loss of sucrose is recorded in certain of the varieties and with a falling off in the bulk of the beets. The fourth weekly chemical analysis of most of the varieties will be given, which brings the report forward to the culminating period of those inimical conditions.

Variety.	Seed.	Date.	Number of beets.	Mean weight of beets.	Brix.	Sucrose.	Purity.
				Gram.	*Per cent.*	*Per cent.*	*Per cent.*
Original Kleinwanzlebener	I	Oct. 2	50	302	15·7	11·6	74·0
Vilmorin Improved	I	...do	50	300	16·3	12·7	77·9
Lemaire	H	Oct. 3	50	387	16·2	11·6	71·6
Do	I	...do	50	372	16·7	12·2	73·0
Desprez	H	...do	50	397	16·7	12·5	74·8
Mette's Specialität	I	...do	50	333	17·2	12·2	70·9
Vilmorin Improved (second planting)	I	...do	50	352	16·9	12·1	71·6
Mette's Rosa Elite	I	...do	50	369	15·1	9·8	65·0

Certain of the varieties were not examined in the fourth week, owing to the small number of beets remaining, many having been destroyed in June by the dust storm, and the remaining few were held back for the final review in the following week.

The loss of sugar, indicated by the table and which had occurred during one week, is appalling. Neither is there any increase in the weight of the beet which in any way can account for the loss. There is a direct disappearance of a large bulk of sugar per acre, and the cause is found in the continuance of high temperature and absence of rain. Rain fell on September 29, but that was too late; the damage was already done. The same cause acted upon the beets, although in the ground, and the same

results followed as are set forth in my experiments of last year, treating of evaporation and loss of sugar under the action of high temperature after the beets were removed from the ground. In the example under discussion, however, the beets were still in the ground, and not fully exposed to the greatest heat of the sun, and it was not to be expected that the sun's action would do more than merely dry out the beets to some degree. The drought had been of long duration, and the water reserve of the ground was extremely low to begin with; by September 15, the beets had shrunk in size to such extent that the finger could be thrust down between the beet and the soil around it, whereas two weeks earlier the soil was adhering close to the sides of the beet and firmly pressing around it. Moreover the foliage had dried up so that nothing but a tuft of young leaves on the head of the beet was remaining, and thus the sun struck with an unbroken force upon the organism. Until the rain of September 29 fell the prospect was quite alarming. Instead of approaching the normal sugar content and purity of juice indicative of maturing, those characteristics were diminishing, and it actually appeared as though the organism of the beet was falling in pieces. The climatic conditions, of which I have spoken, and their action upon the beet appear to have occurred in Europe this year. Robert Hennig, in his weekly letter from Berlin to the Louisiana Planter, remarks, "A most extraordinary circumstance is observed during this hot weather, viz, that the sugar in the juice does not increase." If the sucrose in the juice did not increase, the total sugar in the beets was falling away, because the weight of the beets was shrinking which should have made the sucrose in the juice rise. Mr. Hennig does not note this.

So far the tables given and the observations made upon them have related to the plats which were planted in April and May. At this juncture it will be well to produce data setting forth the behavior of the plats planted a month later and note the comparative action of the climatic conditions upon those beets.

The late beets were planted June 12, and upon the ground where two previous plantings had been destroyed by the wind storms. The plat was planted with six varieties of No. 1 grade home-grown seed and three grades of imported seed, all the conditions being equal. It has already been remarked that this planting germinated in an unusually short time, and the aftergrowth was uninterrupted and rapid. The best cultivation was given to the plats, the ground being absolutely without a weed, and it was being constantly moved by hoeing and cultivating. On September 1 it was estimated that the plats would weigh 14 tons to the acre, and having been so extremely late planted they had yet almost two months for further growth. Up to the date spoken of, September 1, their growth was not abated, and the appearance of the foliage was vigorous and of a deep green color. After the date noted the progress stopped, and it was apparent that even those late-planted plats could not endure any more of the drought.

When it was observed that the heat and continued drought were beginning to affect the late-planted plats and that they were at least ceasing to make weight, an experiment, on a small scale, was made in order to see what actual aid could be given by surface-watering, and what the difference would be between the watered and unwatered at the end of four or six weeks if the natural drought continued. To this purpose a breadth was selected across the whole plats and including all the varieties. From September 1 forward, each day, a little before sunset, all the beets upon the selected breadth were watered by means of sprinkling cans, about 60 buckets of water being supplied daily. When, a month later, the beets were dug up it was found that the water supplied had never gone into the ground deeper than 6 inches, and below that depth the soil was dry and hard. The action of the watering had been much less effectual than good seasonable rains would have been.

These late-planted plats were only analyzed once, because each variety did not contain more than a few hundred beets, most of which it was desirable to keep for seed production in the following year. Consequently the time of analyzing was

when it was supposed the beets had approximately reached their maximum of value in weight and sugar content. The following table gives the results:

Variety.	Seed.	Date.	Number of beets.	Mean weight of beets.	Brix.	Sucrose in juice.	Purity.
				Grams.	*Per cent.*	*Per cent.*	*Per cent.*
Elite Kleinwanzlebener	H	Sept. 28	20	317	20·1	16·4	81·5
Vilmorin Improved	H	...do	20	297	20·5	16·3	80·0
Dippe Kleinwanzlebener	H	...do	20	294	20·7	15·4	74·4
Lemaire	H	...do	20	290	20·2	15·3	75·7
Knauer	H	...do	20	310	20.0	16·3	81·5
Desprez	H	...do	20	298	20·0	15·2	76·0
Original Kleinwanzlebener	I	...do	20	265	22·0	16	72·7
Lemaire	I	...do	20	300	19·3	14	72·5

It is seen that the beets had not attained to more than two parts in three of a normal size. The sugar content of every variety, however, was excellent, and the purity of the juices of several was fairly satisfactory. Although the drought had stopped the growth, the heat had not begun to exhibit its action in the depreciation of the sugar content.

It will be of interest at this place to give the weights per acre of each of the late planted plats, which, with the sugar content, will furnish the actual weight of the sugar per acre:

Variety.	Seed.	Date.	Weight per square rod.	Weight per acre.	Sucrose.	Sugar per acre.
			Pounds.	*Tons.*	*Per cent.*	*Pounds.*
Elite Kleinwanzlebener	H	Sept. 28	172	13·7	16·4	4,513
Vilmorin Improved	H	...do	150	12·0	16·3	3,912
Dippe Kleinwanzlebener	H	.. do	161	12·8	15·4	3,967
Lemaire	H	...do	178	14·2	15·3	4,348
Knauer	H	...do	190	15·2	16·3	4,955
Desprez	H	...do	178	14·2	15·2	4,316
Original Kleinwanzlebener	I	...do	143	11·4	16·0	3,661
Lemaire	I	...do	190	15·2	14·0	4,620
Means of varieties from home-grown seed				13·5	15·8	4,266
Means varieties from imported seed				13·3	15·0	3,990

The weight per acre of all the varieties was low. In the month of August and even to September 1, it was estimated that the plats would attain a yield of approximately 18 tons. The result is almost 5 tons short of that estimate. That the estimate was not immoderate, and that it would have been realized with normal conditions of weather, is indicated by the results obtained where the watering was conducted.

The following table gives the weight per acre of the watered beets, the sucrose in the juice, and the sugar per acre, in comparison with the weight of beets and sugar per acre of the unwatered plats:

Comparison of beets grown on watered and unwatered plats.

Variety.	Watered beets.			Unwatered beets.	
	Weight per acre.	Sucrose.	Sugar per acre.	Weight per acre.	Sugar per acre.
	Tons.	*Per cent.*	*Pounds.*	*Tons.*	*Pounds.*
Elite Kleinwanzlebener	16·3	15·6	5,241	13·7	4,513
Vilmorin Improved	14·0	15·6	4,284	12·0	3,912
Dippe Kleinwanzlebener	15·1	14·4	4,348	12·8	3,967
Lemaire	17·0	15·0	5,100	14·2	4,348
Knauer	16·6	16·2	5,376	15·2	4,955
Desprez	18·3	14·6	5,643	14·2	4,316
Original Kleinwanzlebener	16·2	15·4	4,989	11·4	3,661
Means	16·2	15·3	4,954	13·4	4,238

The comparative columns of this table set forth very clearly the action of the dry weather upon the yield of beets and sugar. The watered beets have produced at the rate of over 700 pounds of sugar per acre in excess of the mean production of the unwatered plats. Consequently, it is quite reasonable to calculate that had rain fallen in moderate proportion during August and early September, the weight of beets would have been increased some 5 tons, and the sugar 1,000 pounds per acre. The same results of the drought were observed in a field of 50 acres grown by the Oxnard Beet Sugar Company in the immediate vicinity of the experiment station.

The effects of the great heat and drought lead me to consider at this place a question of great significance to beet culture in Nebraska. Hitherto the planting of beets on the bottom lands of the Platte Valley has been considered impracticable. Those lands lie very little above the normal flow of the river, the water level in places not exceeding 2 to 3 feet from the ground surface. In the spring, and particularly during the season when the work of early cultivation should be in progress, parts of those lands are frequently under water, and any acts of cultivation are impossible. In very dry seasons, however, all cultural work can be accomplished upon the lowlands as effectually as on the upper lands. This year has furnished an example, which was conducted under the direction of the station. Gottfried Hugo, one of the laborers upon the station during certain parts of the year, received seed from me and planted several rows of beets upon a low-lying patch of ground within the precincts of the town of Schuyler. The spring was moderately dry, which allowed the ground to be worked, and the beets to be planted early in May. The germination was rapid and the beets grew without hindrance or setback up to the time of maturity. On September 23, those beets were analyzed, and at the same time a similar number of beets grown by the same man, and from the same seed, but upon dry, light soil, was analyzed. The following are the results:

	Weight of beets.	Brix.	Sucrose.	Purity.
	Grams.	*Per cent.*	*Per cent.*	*Per cent.*
Moist ground	523	16·3	13·5	82·8
Dry ground	381	16·1	11·0	68·3

The results are worthy of much consideration. The beets on the dry-sand soil were dried out, the leaves had parched and withered. The moist-land beets had still, at the time of analysis, a full foliage, and were not even yet mature. The latter undoubtedly constituted a yield of 24 tons and with not less than 6,400 pounds of sugar per acre; while the production of the sand ground did not exceed 2,500 pounds of sugar to the acre. The results of the moist ground were obtained upon land which in the year 1891 was under water during the whole months of June and July. Good surface drainage and thorough cultivation, with a favorable season for the first crop, enabled a practical man to reach the results of which I have spoken.

BEET PRODUCTION ON THE BOTTOM LANDS.

The importance of the matter in consideration causes me to go outside the work directed by the station in order to consider an experiment upon a large scale of beet production on the bottom lands. The Standard Cattle Company, whose large enterprise is located at Ames, Nebr., in the current season planted 500 acres of beets on certain parts of their ranch, comprising some 6,000 acres. The elevation above the river of different parts of the tract may slightly vary, but the whole is comprised of so-called bottom lands. The resident director of the company, R. M. Allen, has carried out an extensive and excellent system of surface drainage by means of open ditches, the smaller cross ditches emptying into the larger ones, which carry the water off to the river. As a result of the drainage, aided by a favorable spring

time, 500 acres of land were gotten into a condition for planting. The plants grew well from the beginning, and when the dry, hot season set in they still maintained the fresh appearance and growth. A satisfactory yield was obtained and the beets were delivered in good condition to the factory.

In view of the success that has been cited the question of beet culture upon the bottom lands should be reconsidered. The normal rainfall of the region, in combination with the high temperatures and drying winds, makes it very desirable that the ground should possess one factor which may act as a gauge when those climatic conditions are specially adverse. The normal season in Nebraska is somewhat deficient in moisture for beet culture, and wet years, such as 1891, are rare. It is thus probable that upon well selected, well drained, and properly cultivated ground, taking the seasons in the mean, the bottom lands may be uniformly the most reliable for beet production in that State. The indispensable condition is, however, that a system of removing readily the surface water, such as has been carried out by Mr. Allen, must be adopted. Without such drainage beet culture on those lands remains impracticable.

I would suggest that an experiment also be made next season in growing seed upon the bottom lands. The unfavorable factor in seed production upon the upper bottoms and uplands has been the dryness of the soil at the time of maturing the seed. The moisture of the bottom lands will probably control that disadvantage, whilst the Nebraska sun will secure excellent maturity on any land.

COMPARATIVE PRODUCTIONS OF HOME-GROWN AND IMPORTED VARIETIES OF BEET SEED.

The taking of the weights per acre of all the varieties was conducted October 6, and by the method described in my previous reports. The final chemical examination of the beets was made October 12, after an interval of some ten days from the previous analytical review. In the following table the last sugar reading of the crop is given, after which the weights of the varieties will be compared, and the yield of beets per acre, with the sugar content, will make it possible to state the results of each variety, and the comparative productions of the home-grown and imported varieties of seed.

Variety.	Seed.	Date.	Number of beets.	Weight of beets.	Brix.	Sucrose.	Purity.
				Grams.	*Per cent.*	*Per cent.*	*Per cent.*
Original Kleinwanzlebener	I	Oct. 11	50	300	16·6	12·9	77·7
Vilmorin Improved	I	...do	50	312	17·4	14·1	81·0
Elite Kleinwanzlebener	H	...do	50	467	17·8	14·1	79·1
	I	...do	50	391	17·5	13·3	75·0
Knauer	H	Oct. 12	50	489	17·1	13·6	79·5
	I	...do	50	452	17·9	14·0	78·2
Lemaire	H	...do	50	387	17·0	13·2	77·6
	I	...do	50	382	17·0	13·1	77·0
Desprez	H	...do	50	391	17·9	14·2	79·3
Mette's Specialität	I	...do	50	321	17·7	14·0	79·0
Vilmorin Improved (second planting)	I	...do	50	355	17·7	13·9	78·5
Mette's Rosa Elite	I	...do	50	366	15·7	11·7	74·5

These maximum sugar readings of the early planted plats are very low. The beets never recovered from the action of the drought and heat which has been already duly discussed.

The following table gives the weight per acre of the given varieties grown from home-grown and imported seed:

Variety.	Seed.	Date.	Pounds per square rod.	Yield per acre.
				Tons.
Original Kleinwanzlebener	I	Oct. 6	143·0	11·4
Vilmorin Improved	I	...do....	190·0	15·2
Elite Kleinwanzlebener	H	...do....	286·0	22·9
Do	I	...do....	253·0	20·4
Knauer	H	...do....	287·0	23·0
Do	I	...do....	265·0	21·2
Lemaire	H	...do....	235·0	18·8
Do	I	...do....	201·0	16·0
Desprez	H	...do....	247·0	19·7
Mette's Specialität	I	...do....	184·0	14·7
Vilmorin Improved (second planting)	I	...do....	207·0	16·5
Mette's Rosa Elite	I	...do....	230·0	18·4

	Tons.
Mean of varieties from home-grown seed	21·1
Mean of varieties from imported seed	17·9

A further table, embracing the weight per acre and the sucrose in the juice, will furnish the yield of sugar per acre of each variety:

Variety.	Seed.	Weight per acre.	Sucrose in juice.	Sugar per acre.
		Tons.	*Per cent.*	*Pounds.*
Original Kleinwanzlebener	I	11·4	12·9	2,941
Vilmorin Improved	I	15·2	14·1	4,286
Elite Kleinwanzlebener	H	22·9	14·1	6,453
Do	I	20·4	13·3	5,426
Knauer	H	23·0	13·6	6,256
Do	I	21·2	14·0	5,936
Lemaire	H	18·8	13·2	4,963
Do	I	16·0	13·2	4,192
Desprez	H	19·7	14·2	5,594
Mette's Specialität	I	14·7	14·0	4,116
Vilmorin Improved (second planting)	I	16·5	13·9	4,587
Mette's Rosa Elite	I	18·4	11.7	4,305

Mean yield of sugar per acre from home-grown seed, 5,814 pounds.
Mean yield of sugar per acre from imported seed, 4,472 pounds.

The mean of production of the imported seed is specially lowered by the results of the Original variety, which were reduced by the action of the dust storm in June. The mean results of the Elite, Knauer, and Lemaire varieties are the most strictly comparative and conclusive, and are as follows:

	Pounds per acre.
From home-grown seed of those varieties	5,891
From imported seed of those varieties	5,185

The production of sugar per acre from the home-grown seed on the early-planted plats was 706 pounds, or 12 per cent greater than that of the imported seed of the same varieties, under corresponding conditions of soil, climate, and culture.

The mean of the results of the early and late planted plats is shown by the following table:

Time of planting.	Weight per acre.	Sucrose in juice.	Purity of juice.	Sugar per acre.
	Tons.	*Per cent.*		*Pounds.*
May planting	19·5	13·7	78·0	5,538
June planting	13·4	15·4	76·8	4,128
Means	16·4	14·5	77·4	4,833

A further table gives the comparative results of the three seasons during which the station has existed:

Season.	Weight per acre.	Sucrose in juice.	Purity of juice.	Sugar per acre.
	Tons.	*Per cent.*		*Pounds.*
1891	21·7	14·6	85·2	6,236
1892	15·8	15·1	79·6	4,800
1893	16·4	14·5	77·4	4,833
Means	18·0	14.7	80·7	5,290

If the results of the Schuyler Station for the three seasons be compared with the mean results of the sugar-beet station of the French Government at Cappelle, France, for 1891 and 1892, they appear as follows:

Station.	Weight of beets per acre.	Sugar per acre.
	Tons.	*Pounds.*
Cappelle (France)	17·5	5,366
Schuyler (Nebraska)	18·0	5,290

The table giving the results of the station during the three seasons shows that the mean results of this season are almost identical with those of 1892. Both seasons, however, are far behind the very excellent crop of 1891, when the tonnage, sugar per acre, and the purity of the juices were most satisfactory. The conditions which conduced to the very superior results of the crop of 1891 have been fully discussed under the heading of Special Experiments.

SPECIAL EXPERIMENTS.

During the analytical seasons of 1891 and 1892 certain special experiments were conducted with the purpose of determining the loss of weight of the beet by evaporation, and the cause of the loss of sugar which takes place in the organism, particularly during that interval of time between the removal of the beets from the soil and the period of storage in the silos. By means of those experiments it was shown conclusively that high temperature, and particularly the action of strong sunlight, are the primary causes of the decomposition of the sucrose, and that a system of cold storage would effectually protect the organism against such a change in its constituents and the resulting loss of sugar. Those experiments afforded such conclusive data that it has not been considered necessary to continue the experimentation along that particular line this season.

I, however, conducted a series of experiments in order to obtain light upon one other highly important question. It has been, and is still, maintained, and by very noteworthy authorities, that excessive moisture falling upon the beets, either before or after their removal from the soil, causes a decrease or loss in the content of sugar and a signal depreciation in the quality of the beet. The observations made in the experiments of last year and which are found in the report showed conclusively that the fall in the sucrose content of the juice after rains was invariably accompanied by a corresponding, or even greater, increase in the weight of the beet. These observations caused me to doubt wholly the accepted conclusions concerning the action of moisture upon the sugar content. Moreover, there does not appear, physiologically, a probable expectation that such action would transpire. There is, on the other hand, reason for supposing that a deficiency of moisture would retard the formation of sucrose; first, because a normal water content is essential to the elaboration and transport of the constituents in the organism; and further, an

excess of water is indispensable to the formation of the carbohydrates. Scientifically speaking, we have in these considerations the explanation of the decrease of sugar which took place this year in September, of which I have already exhaustively spoken.

This year the specific object was to observe the action of water upon the organism of the beet. The season was peculiarly favorable to the purpose. The experiments were commenced at the period when, as previously related, the beets were depreciating under the influence of drought and heat. The experiments were conducted by taking up a given number of beets, dividing the number into two or more identical parts, and analyzing one part immediately and placing the other part under the action of excessive moisture until analyzed after a definite lapse of time. The work of dividing the original number of beets into identical halves was conducted according to the method used last year, and which was based upon the physiological constant that I had observed, viz: Any two or more lots of beets taken from the same plat and containing the same number of individuals and having the same weight will contain the same total solids and sucrose. Without some such constant, comparative tests would be strictly impracticable, as there would not be a standard of comparison. The constant, whose principle I have expressed, afforded the standard required.

In the examples to be given the beets were taken fresh from the soil, washed and dried and divided into two parts, and each part weighed. One part was analyzed at once and the other part treated as will be explained.

Experiment I.

One hundred and fifty beets were dug up and, after washing, were divided into three "fifties." No. 1 "fifty" were weighed and analyzed directly. No. 2 were weighed and afterwards laid out in the field under normal exposure. No. 3 were packed in a tub with sand and soaked with water, also a large block of ice being laid upon the packed beets, which kept down the temperature, the water overflowing as the ice melted. The weights of the respective parts were identical, each "fifty" weighing exactly 41·5 pounds.

No. 1.—*Analysis of fresh beets.*

Number of beets.	Brix.	Sucrose.
Mean of—	*Per cent.*	*Per cent.*
10 beets	19·9	15·0
10 beets	19·3	14·6
10 beets	20·7	15·8
10 beets	19·5	14·0
10 beets	19·7	14·8
Means	19·8	14·8

The mean purity was 74·2.

No. 2.—*Analysis of exposed beets.*

Mean of—	*Per cent.*	*Per cent.*
10 beets	23·4	18·9
10 beets	23·6	17·9
10 beets	22·5	16·9
10 beets	22·6	16·7
10 beets	22·5	16·0
Means	22·9	17·1

The mean purity was 73·7.

No. 3.—*Analysis of soaked beets.*

Number of beets.	Brix.	Sucrose.
Mean of—	*Per cent.*	*Per cent.*
10 beets	18·4	14·2
10 beets	18·6	14·4
10 beets	18·3	14·0
10 beets	18·1	13·6
10 beets	18·5	14·3
Means	18·3	14·1

The mean purity was 77.

The following table presents an analysis of the results of the three separate analyses:

Beets.	1. Weight.	2. Weight.	Variation of weight.	Brix.	Sucrose.	Content of sugar.
	Pounds.	*Pounds.*	*Per cent.*	*Pr. ct.*	*Per cent.*	*Pounds.*
Fresh beets	41·5			19·8	14·8	6·14
Exposed beets	41·5	34·0	Loss, 19·05	22·9	17·1	5·08
Soaked beets	41·5	44·0	Gain, 6·02	18·3	14·1	6·20

These data not only indicate the actual results, but also the ease with which the indications could be misunderstood. Although the exposed beets give a much higher polariscope reading, an actual loss of 6 per cent of the total sugar had occurred. On the other hand the polariscope reading of the juices from the soaked beets was notably lower, yet those beets had more than maintained their sugar content. It may also be remarked that the moistened beets which had taken up 6·2 per cent of their own weight of water gave a juice of much higher purity, being 3 per cent higher than the fresh beets. In the polariscope tube the juices of the moistened beets read with great ease, whilst the others were difficult to read.

The results of the given experiments were not only satisfactory, but they were striking, from the circumstance that a slight appreciation was observed in the sucrose content and a notable one in the purity. With such a result from placing the beets for seventy-two hours in soaked sand it was determined to experiment with a further number actually submerged in water.

Experiment II.

One hundred beets were dug up, washed, and divided into two identical parts. The first fifty were weighed and analyzed directly. The second fifty were weighed and placed in a tub of water whose temperature was kept at 40°–42° by addition of ice, the tub being placed in one of the silos. The submerged beets remained in the water for precisely seven days. When taken out they were dried and reweighed and immediately analyzed. The following are the results:

No. 1.—*Analysis of fresh beets.*

Number of beets.	Brix.	Sucrose.
Mean of—	*Per cent.*	*Per cent.*
10 beets	17·4	12·0
10 beets	18·4	12·6
10 beets	18·6	13·4
10 beets	19·0	13·4
10 beets	19·2	14·3
Means	18·5	13·1

The mean purity equals 70·8.

No. 2.—*Analysis of submerged beets.*

Number of beets.	Brix.	Sucrose.
Mean of—	*Per cent.*	*Per cent.*
10 beets	16·4	12·7
10 beets	16·7	13·1
10 beets	16·4	12·8
10 beets	16·6	13·1
10 beets	16·5	13·0
Means	16·5	12·9

The mean purity equals 78·2.

Analytical comparison of the results.

Beets.	1. Weight.	2. Weight.	Variation of weight.	Brix.	Sucrose.	Content of sugar.
	Pounds.	*Pounds.*	*Per cent.*	*Pr. ct.*	*Per cent.*	*Pounds.*
Fresh beets	34·5			18·5	13·1	4·51
Submerged beets	34·5	40·0	Gain, 15·9	16·5	12·9	5·16

This table states that the submerged beets took up water during seven days' submersion to the extent of 15·9 per cent of their weight, and that the actual sugar content was increased 14·2 per cent.

In the first place, in consequence of the results obtained, I am obliged to reconsider an observation stated in my report of 1891, in which it is doubted that the beet can increase its sugar content after removal from the soil. These experiments indicate that such an increase has certainly occurred in beets under the conditions in which those examples under consideration were placed. The appreciation in the purity of the juices is also not less notable than the increase in the sucrose. The increment of weight was expected, and particularly considering the wilted condition in which the fresh beets were found. The results are extraordinary. They were, however, conducted with the most extreme care, every act of manipulation in the analysis being performed by me personally, which enables me to vouch for the greatest attainable accuracy.

At the time that the above experiment was completed the beets were suffering to a final degree from the influence of the dry soil and hot sun. A third experiment was made of the same nature as the two already tabulated, but the latter was carried out in the field. In a given plat of beets a certain row was selected and a length of the row including exactly 100 beets was marked off. To those 100 beets 250 gallons of water were given, the loose soil raked up close to the beets to prevent the sun baking the moist surface, and the beets were left for 7 days. At the end of that time those beets were dug up, washed, weighed, and analyzed. At the same time 100 beets comprised within the same length of a paralled row, this row being separated from the watered row by five intervening rows, were taken up, washed, weighed, and analyzed, and the following are the results:

Experiment III.

Unwatered beets.	Brix.	Sucrose.
Mean of—	*Per cent.*	*Per cent.*
10 beets	18.4	14·1
10 beets	18·4	13·3
10 beets	18·3	13·3
10 beets	18·3	13·7
10 beets	19·3	14·0
10 beets	19·3	13·8
10 beets	18·9	13·0
10 beets	19·2	13·7
10 beets	19·0	13·3
10 beets	19·1	12·8
Means	18·8	13·5

The mean purity was 71·8.

Experiment III—Continued.

Watered beets.	Brix.	Sucrose.
Mean of—	*Per cent.*	*Per cent.*
10 beets	16·7	12·6
10 beets	16·8	12·8
10 beets	16·8	13·1
10 beets	17·3	13·4
10 beets	16·0	12·2
10 beets	16·4	12·8
10 beets	15·8	12·2
10 beets	16·3	12·7
10 beets	17·4	13·6
10 beets	16·8	12·8
Total means	16·6	12·8

The mean purity was 77·2.

Comparison of the results.

Beets.	Weight.	Variation of weight.	Brix.	Sucrose.	Content of sugar.
	Pounds.	*Per cent.*	*Per cent.*	*Per cent.*	*Pounds.*
Unwatered beets	78·5		18·8	13·5	10·59
Watered beets	88·5	Gain 12·7	16·6	12·8	11·32

The experiment furnishes results identical with those obtained in the two preceding experiments. It must be observed, however, that in the last experiment the data are not as strictly comparative. The parallel rows from which each 100 beets were taken were apparently similar, but there may have been a small difference in the weight and sucrose content at the time that the beets were watered. No difference, however, could have existed which would have amounted to even 10 per cent of the difference found at the time of analysis. It is most evident that the excessive quantity of water added to the 100 beets (250 gallons, which was 2½ gallons to each beet) not only caused a great increment of weight, but also an immediate formation of sugar, and the appreciation in the purity of the juices is very striking. In each of the experiments it is shown that the presence of excessive moisture raised the purity coefficient most notably, and in the last two experiments 7 and 8 points, respectively. This observation is strictly in accord with the general observations relating to the crops of each season since the station has been in operation. In 1891 the whole cultural season was very wet (see table of the climatics for the three seasons), and at the time that the beets were harvested the ground was saturated with moisture, the rainfall for October of that year being four times greater than the normal. The crop of that season averaged 21·7 tons per acre; the average sucrose in the juice was 14·6 per cent, and the mean purity of all varieties was over 85. In 1892 the crop was notably lighter and the sucrose in the juice higher, owing to the dry season, but the mean purity was less than 80, the soil, mode of culture, and the seed being the same.

In the series of special experiments conducted at the station results have been obtained which are more or less in direct opposition to certain accepted beliefs. Last year the experiments showed that not only no gain but an actual loss, and a very notable loss, of sugar occurs when beets are exposed to atmospheric influences after their removal from the soil; the special causes of that loss being strong sunlight and high temperature. Again, the results of experimentation during this year have indicated quite conclusively that, in an abnormal season, when the beets are depreciating in sugar content and quality, under the influence of high temperature and a dried-out soil, the depreciation can be checked and the conditions reversed by a timely application of water. Further, the observations of this year have shown

that beets can be placed in soaked sand or even submerged in water at a given temperature for a term of seven days, and not only is there no depreciation found, but, with the increment of weight, an increase in the sugar content of the beet and a very notable appreciation in the purity of the juices are observed.

In placing the results of these experiments on record it is desirable and very appropriate that the views which stand in opposition to these results and the noteworthy authorities by whom those views have been held be kept in recollection. A revision of the theories which have been held in relation to the questions under discussion should only be considered when the data supporting some other view are sufficiently conclusive and important to make such a revision imperative.

Before leaving this part of the report the importance of shipping the beets directly to the factory as soon as they are dug up should again be urged upon the beet-growers; I submit also, for the consideration of the factory owners, the results which have been obtained bearing upon the action of excessive moisture in relation to the preservation of the beets. The practice of dumping hundreds and, at times, thousands of tons of beets in dry sheds, where they may lie from a week to ten days before being worked up by the factory, is known to cause fermentation, loss of sugar, and difficulties in manufacture which it is desirable to avoid. I am impressed with the belief that those large masses of beets would be, at any temperature, better preserved by submersion, and would also be in a better condition to be handled in the factory. And in the event of a freeze, which in November may be very severe but of short duration, submersion would be the most perfect mode of preservation.

CONCLUSIONS.

A review of the work of this season and of the results of the seasons of 1891 and 1892 indicates the following conclusions:

Native seed has been produced of excellent quality and high germinating power. The yield per acre, owing to the extreme drouth which prevailed during the maturing season of this year, as likewise in 1892, was lower than would be obtained with an increased rainfall. An experiment in growing seed upon well-selected tracts on the bottom lands of the Platte Valley is recommended.

The comparative experiments in which home-grown seed was planted by the side of imported seed of the same varieties, and under the same conditions of soil and cultivation, have shown the greater vitality and productiveness of the native seed, the latter yielding 706 pounds, or 12 per cent, of sugar more to the acre than the seed imported from France and Germany.

Attention has been directed to the highly satisfactory results which have been obtained in growing beets upon certain tracts of bottom land in the Platte Valley, where an excellent system of surface drainage has been adopted in preparing the land for beet culture.

Special experiments conducted during the seasons of 1891, 1892, and 1893, were devoted to the study of influences causing loss of weight and sugar in the beet and to modes of preventing such loss. It has been found that high temperature and direct sunlight are the main causes of the decomposition of sugar in the organism, and that storing at low temperature prevents such decomposition. Moreover, the experiments of this season have indicated that excess of moisture is not an immediate cause of depreciation of quality in the beet, and that, under given conditions, submersion of the beets in water for a limited length of time may be found an excellent mode of preservation.

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